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L. Agassiz

THE ANNUAL

OF

SCIENTIFIC DISCOVERY:

1596

OR,

YEAR-BOOK OF FACTS IN SCIENCE AND ART.

EXHIBITING THE

MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS IN

MECHANICS,	ASTRONOMY,	MINERALOGY,
USEFUL ARTS,	METEOROLOGY,	GEOLOGY,
NATURAL PHILOSOPHY,	ZOÖLOGY,	GEOGRAPHY,
CHEMISTRY,	BOTANY,	ANTIQUITIES.

TOGETHER WITH A LIST OF RECENT SCIENTIFIC PUBLICATIONS; A CLASSIFIED LIST OF PATENTS; OBITUARIES OF EMINENT SCIENTIFIC MEN; AN INDEX OF IMPORTANT PAPERS IN SCIENTIFIC JOURNALS, REPORTS, ETC.

EDITED BY
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PREFACE.

THE idea of preparing the present work was first suggested by the examination of similar works, which have been published in Europe for several years past. We believed that such a work could not fail to be useful to many persons, by enabling them to see at a glance what has been accomplished during the past year, and thus showing them in what direction they can most profitably apply their labors. The language of Bacon concerning one branch of science applies with equal force to all its branches:—"Nothing is of greater efficacy in procuring a stock of new and useful inventions, than to have the experiments of numerous mechanic arts known to a single person or to a few, who might mutually improve each other by conversation; so that by this translation of experiments, arts might mutually warm and light up each other, as it were, by an intermingling of rays."

In the preparation of the Annual, nothing has been inserted except upon good authority. While many of the articles have not been previously in print, many others have been furnished directly to us by their authors, but have also been published elsewhere. In the exercise of a proper discretion, we have rejected some articles which it would perhaps have been well to retain; but the limits assigned to the work compelled us to omit much that we at first intended to include. We have, however, inserted nearly all that is at once new and important which is to be found in the standard scientific publications of America, Great Britain, France, and Germany.

Although great care has been bestowed upon every portion of the

work, it would be presumptuous for us to hope that we have been entirely successful in our earnest endeavors to render the Annual perfectly accurate, and we must plead, in excuse for any errors which may be detected, the peculiar difficulties necessarily attending the preparation of the *first* volume of a work of this nature.

We must not neglect this opportunity of acknowledging the aid we have received from many distinguished gentlemen, but especially from Professors Agassiz, Horsford, and Wyman, and Dr. A. A. Gould, whose counsel and assistance have greatly aided us in our labors. To Messrs. Folsom and Fairbanks, of the Boston Athenæum, and Messrs. Harris and Abbott, of the library of Harvard College, we are indebted for many facilities.

Should this our first volume receive the approbation of the public the work will be continued annually; and while we hope hereafter to be free from some embarrassments which have prevented us from making it as complete as we could desire, the experience already gained and the aid promised for the future will, we believe, enable us to render the succeeding volumes more satisfactory both to the public and ourselves.

We shall be happy to receive original communications relating to new inventions or discoveries, for insertion in the next volume.

CAMBRIDGE, March 1, 1850.

NOTE TO THE SECOND EDITION.

THE Editors have improved the opportunity afforded by the rapid sale of the first edition and the consequent demand for a new one, to correct a few slight errors, which had previously escaped notice. The list of scientific publications and the index to articles in scientific journals have been considerably enlarged. We hope, hereafter, to render this important feature of the work still more valuable.

APRIL 10, 1850.

LOUIS AGASSIZ.

[SEE THE FRONTISPIECE.]

Professor Agassiz is a native of Switzerland, and was born in the Canton of Friburg, in the town of Mottier, on the 28th of May, 1807. His ancestors were of French origin, and were among those Protestants whom the revocation of the Edict of Nantes obliged to leave France.

The father of Agassiz was a Protestant minister, and it was expected that his son, following the example of his ancestors, would devote himself to the service of the Church. But Natural History, which from an early age strongly arrested his attention, had, on the completion of his studies at school, gained so great an ascendency, that he chose the profession of medicine, as offering the best opportunities for prosecuting his favorite pursuits. He commenced the study of his profession at the Academy of Zurich, whence he went to the University of Heidelberg, where he devoted himself especially to the study of anatomy, under the direction of the celebrated Professor Tiedemann. At the University he was noted, not only for assiduity in study, but for the rare talent of managing with equal dexterity the rapier and the scalpel. From Heidelberg he went to the University of Munich, where he remained four years. Before this Agassiz had commenced lecturing to his fellow-students, and his already extensive knowledge of Natural History soon attracted the notice of scientific men and his instructors. So great was his reputation, that he was employed by Martius to prepare the ichthyological department of the Natural History of Brazil, a work which gained him great credit.

At this period, his parents, disliking his exclusive devotion to science, withheld his allowance; but his enthusiasm procured him advances from Cotta, a bookseller. Having, however, gained the degrees of Doctor of Medicine and Philosophy, he went to Vienna, where he applied himself to the study of existing and fossil fishes. A friend having lent him some money, he visited Paris, and here gained the friendship of Cuvier and Humboldt, with the former of whom he remained until his death, in 1832.

Having returned to Switzerland, he was appointed Professor of Natural History in the University of Neufchatel, a place which he filled until his departure for the United States. In 1833 he commenced the publication of his great work, *Poissons Fossiles*, in five volumes, with an atlas of about four hundred folio plates, and comprising descriptions and figures of nearly a thousand species of fossil fishes. This work gained for him the respect of the scientific world, and at the age of thirty-four Agassiz was a member of every scientific academy of Europe. The degree of Doctor of Laws was conferred upon him by the Universities of Edinburgh and Dublin, and he was also admitted to the freedom of those cities. The Order of Knight of the Red Eagle of Prussia was conferred upon him by the king of Prussia.

Since 1833 his publications have been very numerous. Among them are works on the Echinoderms and on the Fossil Mollusks of the Jura, a German translation of Buckland's Geology, with copious notes, and his Fresh-water Fishes of Europe. The *Nomenclator Zoologicus*, published some years since, and the *Bibliographie Générale d'Histoire Naturelle*, lately published by the Ray Society, are the product of several years' observation.

In 1837 Agassiz first promulgated his "Glacial Theory," which has ever since attracted much attention. It having been asserted that it was inconsistent with known facts, Agassiz for eight years spent his summer vacations in making observations at the Glacier of the Aar, eight thousand feet above the sea, and twelve miles from any other habitation than his own hut. The result of these examinations are contained in two works, *Etudes sur les Glaciers*, and *Système Glacière*.

In 1846 Agassiz came to America, and on the establishment of the Lawrence Scientific School he accepted the appointment of Professor of Zoölogy and Geology, which he still holds. Since his arrival in this country, Professor Agassiz has presented a large number of communications to the American Academy and other scientific bodies, and has published, in connection with Dr. Gould, of Boston, a Zoölogy for students. His elaborate work on Lake Superior has just appeared.

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ANNUAL OF SCIENTIFIC DISCOVERY.

MECHANICS AND USEFUL ARTS.

SUSPENSION BRIDGE OVER THE OHIO AT WHEELING.

FROM the report of the engineer who has charge of the Wheeling Suspension Bridge, we derive the following facts. The span of the bridge from centre to centre of the supporting towers is 1,010 feet, which is 152 feet longer than the bridge at Friburg in Switzerland, the longest span hitherto constructed. The height of the flooring is 97 feet above the low-water level of the river, and 58 feet above the highest flood ever known, except the celebrated one of 1832. The towers over which the suspension chains pass are built upon the abutments, and that at the eastern side rises 153½ feet above low-water, and 60 above the abutments; the other tower varies slightly from this measurement. The wire cables which support the flooring are 12 in number, 1380 feet long, and 4 inches in diameter. These cables rest on iron rollers, placed on the summits of the towers, the movements of which will relieve the towers of the strain consequent upon the contraction and elongation of the wires, occasioned by the changes of temperature. The flooring is 24 feet wide, divided between a carriage-way of 17 feet, and two footpaths of 3½ feet each. The length of the wood-work resting on the cables is 960 feet, and its weight is 546 pounds per lineal foot, making a total of 524,160 pounds, or 262 tons. In each cable there are 550 strands of No. 10 wire. The weight of each lineal foot of the 12 cables, which are composed of 6,600 strands, is 330 pounds, making, with the weight of the timbers, bolts, &c., a total of 920 pounds per lineal foot, or 634 tons as the permanent weight of the bridge. But, in addition to its own weight, it is intended to support the largest weight that can be brought upon it at one time. If filled from one end to the other with a double row of the heavy wagons used on the National Road, it is calculated that an additional weight of about 600 tons might possibly be brought upon it. But it is ascertained by a machine, that the aggregate strength of the 6,600 strands

of wire composing the 12 cables is 4,950 tons, so that they will in an ordinary state of the bridge be capable of supporting five times the strain which they are actually called upon to bear; and when the platform is filled with loaded teams they will have the power of resisting three times the strain produced by the bridge itself, and three times the additional strain produced by the teams. The anchorage of the bridge is formed on the Wheeling side by very heavy anchoring-irons, which are imbedded in the earth, and surrounded on all sides by a ponderous pile of massive masonry. On the island side, continuous links of wrought iron are imbedded in the massive wing walls, so that there need be no apprehension of a failure in this portion of the structure. This bridge was built by a joint stock company, who have a charter from the State of Virginia, and the engineer is Charles Ellet, Jr.

IRON-ARCHED BRIDGE ON THE PENNSYLVANIA CENTRAL RAILROAD.

THE chief peculiarity of this bridge consists in its *iron-arch*, which is extended to a very considerable span, and furnishes a highly important test of the powers of resistance, both of the material itself and of the particular form in which it is used. At the same time it is perfectly safe, for if the arch fails, the truss without is sufficient to sustain any weight that can come upon the bridge. The general arrangement of the truss is that of the well-known Howe Bridge. The arch is constructed of a centre rib of cast iron, 7 inches deep, with upper and lower horizontal flanches, 5 inches wide; two rolled iron plates are placed on the top and two on the bottom of the cast rib, breaking joint with the rib and with each other, and secured by clamps at proper intervals. Below the chords are solid cast-iron skew-backs, and castings of suitable form to connect with the skew-back and to receive the ends of the arch are placed on the top of the lower chord. As it was believed that the failure of cast-iron bridges generally results from the inequality of pressure upon the joints, they were separated to the distance of one fourth of an inch, and spelter was poured into them in a melted state. The castings were made with inch holes near the ends, through which rods were passed to assist in raising them. The most important advantage to be derived from the peculiar arrangement exhibited in this structure was the practical test of the power of resistance of a counter-braced iron arch on a large scale. The counter-braces being placed above the arch, and resting against it by adjusting or set screws, and there being at short distances vertical posts of oak, also terminating in a set screw resting on the arch, it will be readily perceived, that, by loosening the counter-brace screws, and tightening those on the posts, the bridge will be raised upon the arch, so that the latter will bear the whole weight of the truss and its load. This experiment has thus far proved entirely successful, and shows that the counter-braced arch, which is the lightest and cheapest system possible, is also perfectly reliable for spans of any magnitude. In the *Franklin Institute Journal* for September, from which we abridge this

article, a series of observations on the working of the bridge is given with some minuteness, especially those with reference to the expansion and contraction of the iron, all of which were perfectly satisfactory.

THE BRITANNIA TUBULAR BRIDGE.

IN describing this great triumph of modern art, it will be at once the easiest and the clearest mode of proceeding to divide our description into four parts. 1. The principle upon which the bridge is constructed. 2. The mode of construction. 3. The floating of the tubes. 4. The manner in which they were subsequently raised. And, first, as to the principle of the construction. In constructing a railway from Chester to Holyhead, the great difficulty to be surmounted was to discover a means of transporting the trains across the Menai Strait, between Caernarvon and the island of Anglesey. The point selected for crossing is as narrow as could be found, but is exposed to tremendous gales of wind. The Admiralty insisted that the bridge must be sufficiently high above the water to allow of vessels passing under it freely, 100 feet being the space required, and they also forbade that any scaffolding or centring should be used. After much deliberation, Mr. Stephenson selected the plan of two cast-iron arches, which were to be made to balance each other in the centre, in a manner that has been pronounced, by a high authority, "one of the most beautiful structures ever invented." But the Admiralty vetoed this, as not leaving the requisite space except at the centre of the arches. Mr. Stephenson then resorted to the present plan, whose principle is to have the trains pass through long, low, straight, hollow tubes, one for the up trains and one for the down ones, composed of wrought-iron "boiler plates," firmly riveted together. The tubes he decided to have oval or elliptical in shape, to turn aside the force of the winds, and with the ends resting on abutments of masonry. To complete his plan he had three intermediate towers between the abutments, one to be constructed at high water-mark on each side of the strait, and the third, no less than 210 feet in height, to be erected near the middle of the stream, on a small rock. The four lengths of each of the twin tubes he proposed to have as follows:—from the Caernarvon abutment to the tower at high-water mark, 274 feet; from the latter tower to the central Britannia tower, 472 feet; from the central tower to that at high-water-mark, on the Anglesey shore, 472 feet; and thence to the Anglesey abutment, 274 feet, giving for each line of tubes a total length of 1,492 feet.

Having formed his plan, Mr. Stephenson recommended that experiments should be made to test the proper strength of the various parts, the shape, &c., which was done, and the results we give * in another article. It is sufficient to remark here, that it was found that the tubes should be stronger at the top than at the bottom, and that the shape should be rectangular. It was also determined that the four shortest galleries, each 230 feet long, should be at once constructed upon scaffolds, in the positions in which they were to remain;

* See page 81.

while the four longest galleries, each 472 feet long, should be constructed upon wooden platforms, at high-water-mark on the Caernarvon shore, and should be floated to the foot of the towers on pontoons, thence to be raised to their positions by hydraulic presses.

II. *Construction of the Tubes and Towers.*—A platform was at once constructed of balks of timber covered with planks, for the building of the tubes, and near this platform, which was half a mile long, were erected workshops, with the requisite forges and machinery. Several wharves were built and six steam-engines procured. 700 men were employed on the iron work, and 800 on the stone for the towers. We will describe the construction of the various portions.

Plates.—The wrought-iron plates which form the top, bottom, and sides of the Britannia "land tubes," 230 feet in length, are, of course, slighter than those required for the four, each 460 feet, which overhang the stream.

For these long tubes, which are of the same height and breadth as the shorter ones, the dimensions of the plates are as follows:—

For the bottom: 12 feet in length, 2 feet 4 inches to 2 feet 8 inches in breadth, $\frac{7}{16}$ to $\frac{1}{2}$ inch in thickness.

For the top: 6 feet in length, 1 foot 9 inches to 2 feet $\frac{1}{2}$ inch in breadth, $\frac{5}{8}$ to $\frac{3}{4}$ inch in thickness.

For the sides: 6 feet to 6 feet 6 inches in length, 2 feet in breadth, $\frac{1}{2}$ to $\frac{5}{8}$ inch in thickness.

Although these plates have been severally forged with every possible attention, yet, to render them perfect in thickness, they are not allowed by Mr. Stephenson to be used for the tubes until each has been passed by the company's superintendant between two massive iron rollers, worked by steam, which, by revolving, squeeze down the pimples, that, from unequal contraction in the process of cooling, often disfigure the surface of plate iron. When the plates, the largest of which weigh about seven hundred-weight, have been thus accurately flattened, they are, one after another, according to their dimensions, carried by two or more men towards one of several immense cast-iron levers, which, under the influence of steam, are to be seen from morning till night ascending and descending once in three seconds.

Beneath the short end of this powerful lever there is affixed to the bottom of a huge mass of solid iron a steel bolt, which, endowed with the enormous pressure of from 60 to 80 tons, sinks at every pulsation of the engine, into a hole rather larger than itself, perforated in a small anvil beneath.

As soon as the laborers of the department bearing each plate arrive at this powerful machine, the engineer in charge of it, assisted by the carrying men, dexterously places the edge of the iron upon the anvil in such a position that the little punch in its descent shall consecutively impinge upon one of a series of chalk dots, which, at 4 inches from each other and $1\frac{1}{2}$ inch from the edge, have been previously marked around the four sides of the plate; and thus four rows of rivet-holes, averaging an inch in diameter, are, by the power

we have described, pierced through the plate-iron from one half to three fourths of an inch in thickness.

Some of the steam-arms or levers just described are gifted with what may be termed "double thumbs," and accordingly these perforate two holes at a time, or forty per minute,—the round pieces of iron cut out falling, at each pulsation of the engine, upon the ground, through the matrix or perforation in the anvil.

When the plates, averaging from six to twelve feet in length, by above two feet in breadth, have been thus punched all around, and before they are brought to the tube, they are framed together on the ground, in compartments of about twenty plates each (five in length and four in breadth), in order to be connected to each other by what are termed covering-plates and angle-irons.

In order to prepare the former (which are half an inch in thickness, one foot in breadth, and about two feet long), they are heated in a small furnace, when, instead of passing between rollers, they are put under a stamping, or, as it is technically termed, a joggling-block, which, by repeated blows, renders their surface perfectly flat; after which a series of holes, corresponding in size as well as in distance from each other with those in the "plates," is punched all along the outer edge of each of their four sides. When thus prepared, two of these small covering-plates, one on each side, are made to cover and overlap the horizontal line of windage existing between the edges of the plates, which, as we have stated, have been previously arranged so as to touch each other; and bolts being driven through the corresponding holes of the three plates (the large plates lying between the two covering ones), they are firmly riveted together by the process we are going to describe.

In the construction of the Britannia tubes there have been required no less than two millions of bolts, averaging seven eighths of an inch in diameter and four inches in length. The quantity of rod-iron consumed for this purpose has, therefore, amounted in length to 126 miles, and in weight to about 900 tons! The mode in which these legions of rivets have been constructed is briefly as follows. At the western end of the company's principal forging establishment there stands a furnace or trough, full of pieces of rod-iron, from 3¾ to 4¾ inches in length. As soon as, by the bellows worked by steam, they have been made uniformly red-hot, a little boy picks them out one after another through the furnace-door with a pair of pincers, from which he drops them perpendicularly into eight moulds, each of which being about three quarters of an inch shallower than the length of the piece of iron it respectively receives, they, of course, all equally protrude about that distance above the surface. They are then placed upon an anvil, and the protruding portion is flattened by a hammer worked by steam, so as to become at once a bolt.

As soon as each "set" of the half-inch iron plates which form the sides, top, and bottom of the Britannia tubes have by a travelling crane been lifted—technically termed "picked up"—into their place, and have been made to touch each other as closely as possible, a movable stage on wheels is drawn close to the outside of

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tube, for the purpose of firmly connecting every set of plates to that which on each side adjoins it. This work is performed by what is termed "a set of riveters," composed of two riveters, one "holder-up," and two rivet-boys.

As soon as the first two have ascended the scaffolding on the outside of the tube, and when the holder-up, sitting on a board suspended by ropes from the roof, has exactly opposite to them taken up his position on the inside, one of the boys quickly abstracts from a travelling furnace, conveniently placed for the purpose, a red-hot bolt, which by a circular swing of his pincers he hurls inside the tube towards the other boy, who, as actively as possible, with a similar instrument snapping it up, not only runs with it towards the holder-up, but as long as he can reach the rivet-holes inserts it for him. As soon as this is effected, the holder-up presses against it an enormous iron hammer, which forces it outwards until it is stopped by its own head. The two riveters then hammer it on the outside, so that a head is formed there, and it becomes now a rivet, which, by contracting as it cools, binds together the plates even more firmly than they had already been almost cemented by the irresistible coercion of three sledge-hammers; indeed, they are so powerfully drawn together, that it has been estimated that it would require a force of from four to six tons to each rivet to cause the plates to slide over each other.

The bolts for the upper holes of the interior, which, being about thirty feet high, are of course completely out of the rivet-boy's reach, are dropped by him into a concentric iron ring, which, by a wire and cord passing over a pulley attached to one of the uppermost plates, is rapidly raised, until the holder-up is enabled by pincers to grasp the fiery iron, which, on being inserted into its hole, he then instantly, as before, presses with his hammer. By the operations above described, "a set of riveters" usually drive per day about 230 rivets, of which in each plate there are about 18 per yard in two rows, averaging only 2¼ inches of clear space between each bolt-head. On the large tubes alone there have been employed at once as many as 40 sets of riveters, besides 26 "platers," or men to adjust the plates, each having from three to four men to assist him; and when this well-regulated system is in full operation, it forms altogether, not only an extraordinary, but an astounding scene.

But by far the most curious part of the riveting process is to be seen on the flat roof or top of the tube. This immense deck, which we have already stated to be 472 feet in length, is composed of a pavement of plates to be connected together by eighteen longitudinal rows of rivets, the heads of which are to be only 2½ inches apart. Beneath this surface, at a depth of only 1 foot 9 inches, there is, to give additional strength, a similar stratum of plates, the space included between both being divided into eight compartments called flues, 21 inches deep by 20 inches broad, exactly resembling those of a common stove. After the horizontal bottoms and upright sides of these eight flues have been firmly connected together by the battering process we have just described, the upper stratum of plates is loosely laid down, and, being thus by the superincumbent weight of the iron

covering securely adjusted, their final connection is effected as follows. A "rivet-boy" and a "holder-up" crawl into one of these flues, and having got arranged in there, at a signal red-hot rivets are passed through holes, made for the purpose, to the boy, who delivers them to the holder-up, and he in turn drives them through rivet-holes to the outside, where they are also pounded, so as to form a head there. It is extraordinary how any person can work from morning till night, as these do, in a space hardly large enough to lie down in. The plates, having been thus adjusted in the positions best suited to resist the strains they will have to bear, are finally connected together by small ribs riveted to them. The quantity of *angle-iron* thus worked up, through the top, bottom, and sides of all the tubes, amounts to 65 miles.

The Britannia tower in the centre of the strait is at the base 62 feet by 52, and rises to a height of 230 feet. This enormous structure, which weighs over 20,000 tons, contains 148,625 cubic feet of Anglesey marble for the exterior, 144,625 cubic feet of sandstone for the interior; and 387 tons of cast-iron beams and girders, worked into it, give strength and security to the mass. The province of this tower is to sustain the four ends of the four long iron tubes which will span the strait from shore to shore. The total quantity of stone contained in the bridge is 1,500,000 cubic feet. The side or land towers are each 62 feet by 52 in the base, and 190 feet high. They contain 210 tons of cast iron.

III. *The Floating of the Tube.*—The props on which the tube rested having been removed, so that it was supported only at the ends, it was found that now the slightly circular form of the bottom, became, as was intended, perfectly straight. The pontoons, eight in number, each 98 feet long, 25 wide, and 11 deep, were built with valves in the bottom to let in or keep out the water at pleasure, and were capable of bearing a weight of 3,200 tons, though the tube weighed but 1,800. From these pontoons, hawsers, whose united length was over two miles, were passed to capstans on the two shores, and on the Britannia tower, and when, at the signal, the Caernarvon ropes were cut, the tube at once slid on to the pontoons. It was then slowly floated by the tide down to the position from which it was to be raised, where it was securely fastened.

IV. *Raising the Tube.*—The tube was raised by means of an hydraulic press of immense power. The cylinder or large tube of the syphon of the press, which is 9 feet 4 inches long, 4 feet 10 inches in diameter, and which is made of cast iron 11 inches thick, weighs 16 tons. The whole machine, complete, weighs over 40 tons. Its lifting power is 2,622 tons, and it has force enough to throw water 5,000 feet higher than Mont Blanc. The manner in which this immense machine works is as follows. Its position on the Britannia tower is 148 feet above the level of the water, and about 45 feet above that to which the tube must be raised. Around the neck of the iron ram or piston is affixed a strong horizontal iron beam, from the extremities of which hang two enormous chains, composed of eight or nine flat links or plates, 7 inches broad, 1 inch thick, and 6 feet long, firmly

bolted together. These chains being each 145 feet long, weigh no less than 100 tons. The press being put in operation, in about thirty minutes it raises the tube 6 feet, and here it stops till the masonry can be built up under the tube, when it takes another "hitch" of the same length. It was during one of these "hitches," that one of the presses, for there must of course be one for each end of the tube, broke, owing to some defect, and the tube fell seven inches to the masonry below; but it was not at all injured, though several of the workmen were considerably hurt. After this accident, the hoisting was obliged to be stopped till a new cylinder could be cast, and the time was occupied in further strengthening the various portions of the ponderous machinery. Operations, however, were soon renewed, and on the 15th of October, the tube was raised to its permanent level of 100 feet above high-water-mark.

The other tubes are to be floated and hoisted as soon as the preparations can be made. When all the tubes are in place, they are to be firmly bolted to the piers, and those in each line will be firmly connected together, and after this the extremities of each line are to be lowered about 15 inches, by removing false foundations, and this will add materially to the strength of the whole. Rollers are placed under the tubes on the two abutments, to allow of contraction or expansion with the changes of the weather. The whole iron passage is 1,841 feet long. The expense of the whole work will be about 600,000 pounds sterling.—*Derived from the London Quarterly for October.*

NOVEL SUSPENSION BRIDGE AT CHESTER (WALES).

IT was necessary to erect this bridge in a situation where it was found advisable to dispense with piers and suspension-rods projecting above the level of the road, and as the ravine to be crossed was 150 rods wide, and it was doubtful whether a proper foundation for the erection of heavy stone piers could be obtained, recourse was had to what is called the self-adjusting principle. The chain-rods are made of the best seven-eighths round iron, in lengths of 15 feet each, with secure lock-joints placed alternately. Across these are fitted flat bars above and below, about six feet apart, upon which the wooden planks forming the platform are firmly secured by bolts and nuts screwed up from below. The chain rods are secured at one end to a massive stone pier, by strong cramp plates and bars, built in from the foundation on the Grosvenor side, while the stone pier at the other end of the bridge is formed into a pit. On the top of this, resting on cast-iron girder beams and pedestals, is placed a very strong grooved barrel, around which each of the chains is made to take one turn, descending to a strong cast-iron plate, which is suspended near the bottom of the pit at the depth of 30 feet, to which it is fastened. Upon this plate a mass of masonry is built, forming a weight sufficient to counterbalance the whole weight of the rest of the bridge, and keeping the chain-bars in a proper state of tightness, as well as providing for contraction and expansion. We thus have the novel plan of a suspension bridge which is fastened at one end to a pier of masonry, while at the other the sus-

pension chains or rods are held by a large mass of masonry built upon a suspended plate, to which they are fastened. There are, however, in order to give additional security, back stay-rods at each end, which run a considerable distance into the ground, and are fastened to massive oak frames, thus giving an additional resisting force of many hundreds of tons of earth.

PROPOSED SUSPENSION BRIDGE OVER THE DNIEPER.

There has lately been exhibiting in London a large model of a suspension bridge, which is about to be erected over the River Dnieper, by order of the Emperor of Russia. When completed, the bridge will be half an English mile long, thus forming the longest suspension bridge in the world. It is proposed to have five piers, besides the two abutments, making four openings of 444 feet each, and two of 222 feet. The roadway will be 34 feet wide, with a footpath of 6 feet, and on the Russian side of the river there will be a small revolving or swivel bridge, by which the communication with the Polish side of the river can be at once cut off. This swivel bridge will communicate with the rest of the structure by an island formed of masonry, which will be so constructed that any injury which happens to the chains within it can be easily repaired. The work will, on account of its frontier situation, be strongly fortified, each of the immense piers on which the chains are swung being intended to be mounted with cannon. Five years will be required to complete this extensive structure.

GIRDER BRIDGE ON THE MANCHESTER, SHEFFIELD, AND LINCOLNSHIRE RAILROAD.

On the Manchester, Sheffield, and Lincolnshire Railroad, a bridge has just been completed across the River Trent, which is of a similar character with the Britannia Tubular Bridge, but it differs from it in this important respect; that, instead of being intended for the trains to run through the inside of the tube, the girders form the parapets of the bridge, and the road-way is supported by transverse wrought-iron hollow beams, also of tubular construction. This bridge is called the *Hollow Girder Bridge*, to distinguish it from the Britannia Bridge, and it is the largest one of the sort yet constructed. The stone-work consists of a centre pier and two elliptical arches of 50 feet span, terminating by substantial abutments. The iron part of the structure consists of two spans of 154 feet each, which with the land arches and abutments give a total length of about 460 feet. The principal girders are each 336 feet long, 12 high, and 3 feet 1 inch wide. The tops of the girders are formed of two cells 18 inches wide and 12 deep, to resist compression. The girders are fixed securely on the middle pier, but on the abutments their ends are supported upon rollers, resting on cast-iron plates, bedded into the masonry to admit of expansion and contraction. On the outside of the girders are riveted two parallel lines of angle-iron in the form of an arch, which spring from the middle pier to the abutments on each side. The two principal girders

weigh 150 tons each; the transverse beams, placed 4 feet asunder, weigh 82, and the cast-iron 10, giving 392 tons as the total weight of the bridge. The girders were constructed on one side of the river and hauled across on rollers to the other side; but great difficulty was experienced in this, as of course the girders during this process could rest upon but few points, and one end of them must sometimes be suspended for 120 feet, before it received any auxiliary support.—*English Railway Chronicle.*

SUSPENSION BRIDGE AT PESTH.

The suspension bridge which is erected over the Danube, at Pesth, was commenced in 1840, under the direction of an English engineer, and was finished in January, 1849, at a cost of 3,200,000 dollars. This bridge has a clear water-way of 1,250 feet, the centre span or opening being 670 feet. The height of the suspension towers from the foundation is 200 feet, being founded in 50 feet of water. The sectional area of the suspending chains is 520 square inches of wrought iron, and the total weight of the same is 1,300 tons. This is the first permanent bridge which has been erected over the Danube below Vienna since the time of the Romans.—*Journal of Franklin Institute for May.*

APPARATUS FOR FEEDING STEAM-BOILERS.

A patent has been issued to Mr. Warren S. Bartle, of Newark, N.J., for an improved apparatus for feeding steam-boilers. It is difficult to give a correct idea of it without the aid of plates, but we will endeavour to describe the more important parts. A small cylinder is erected and attached to a convenient part of the boiler, communicating with it by a pipe above for steam, and one below for water. A float is placed in this cylinder, which as it rises and falls turns a cock, to shut off and open the suction-pipe of a force-pump, so as to regulate the supply according to the depth of water in the boiler. To effect this turning of the cock, the float is connected by a rod to an arm, which passes through a steam-tight bearing box. Fastened to this arm is a wire, which is nicely balanced on it, and is fastened below to two adverse ratchets, which in turn are accurately balanced on pivots in a small upright standard. As the float rises and falls in the cylinder, these ratchets turn a ratchet-wheel, which shuts or opens the suction-passage of the force-pump. The passage is opened to its greatest extent when the float is at its lowest line, and when it is at a certain height it is shut up entirely. By some additional machinery the action of the pump is wholly shut off, and the inventor claims as his, various modifications of this apparatus.—*Scientific American.*

NEW STEAM-BOILER FEEDER.

The *Scientific American* describes another new apparatus for feeding boilers, whereby the force-pump is done away with. It is so constructed that the water will be kept continually at the water-line, and

the principle of it consists in bringing a receiver alternately in communion with the water-tanks, and then with the steam and water of the boiler, so as to receive the water in the one case, and pass it into the boiler by the steam at the water-line in the other case. To effect this there is a small revolving disk driven by a pinion, which works steam-tight between two metal plates, communicating with the boiler by a tube passing down into the water in it. Above it communicates with the water-tank by a pipe and also with the steam. The revolving disk has a receiver in it, which takes the water from the tank above, carries it round between the upper and lower plates until it is passing above the feed-pipe into the boiler below, when it is at once brought into connection with the steam-pipe above, and the water is deposited in the boiler. It will be observed that if the water is up to the line of the revolving disk, the water in the receiver will not be pressed into it, but will be carried round. It can be operated by a reciprocating motion, and its principle is like that of the slide-valve. It is the invention of Mr. Foskit, of Meriden, Connecticut.

STEAM GENERATOR.

The *London Times* contains an account of a new invention called "Wright's Patent Steam Generator," some experiments with which have been entirely successful. The principle of the invention consists in applying to the boilers of steam-engines an arrangement of what are called "cellular vessels," formed of malleable cast-iron, one vessel being placed underneath the boiler and over the fire, while the other is placed within the boiler. They are connected by means of bent tubes, so as to have a free communication with each other, but are insulated as regards the water in the boiler. They are charged with water, which, except from any slight unavoidable waste, is never changed, and there is a small safety-valve connected with them, which is so loaded that the temperature of the insulated water contained in the cellular vessels may, if necessary, be raised to 400 degrees or 500 degrees of Fahrenheit without forming into steam. The vessels, therefore, remain perfectly charged, and the insulated water in the lower vessel taking up the principal portion of the heat of the fire, rises by its inferior gravity through the bent tubes, and is diffused through all parts of the cellular vessel within the boiler. The excess of heat is there instantly given off to the water in the boiler, and the insulated water descends by increased gravity to take up a fresh charge of heat. The result of the experiments made with this ingenious invention was an evaporation at the rate of 12.8 pounds of water to 1 pound of coal, the rate given by the present construction of boilers being stated at 8 pounds of water to 1 pound of coal. Besides the saving of fuel which would thus appear to be effected, there is also the obvious advantage that the flame hardly impinges upon the boiler from the intervention of the cellular vessel, and the boiler is thus saved from the rapid deterioration to which it is now exposed by the excessive heat which plays upon it. The principle of the invention is equally applicable to every boiling and evaporating process, but if after a more ex-

tensive practical experience it is found to answer, the economy which it secures will probably be most advantageously felt in the case of marine engines, the space required for the stowage of fuel in steam-vessels being at present so very large. Mr. J. Gooch, of the South-western Railway, has tested Mr. Wright's patent, and the result corresponds exactly with that obtained on Saturday, when 56 pounds of coal evaporated 720 pounds of water in the space of an hour and 12 minutes.

DISK ENGINE.

The improved disk engine which has been fitted up for the purpose of driving the printing presses of the London Times occupies the wonderfully small space of seven feet in length by four in width, and its highest part is but three feet above the floor of the room. The peculiarity of the engine is, that it gives direct motion to a crank on the engine shaft, and exerts a perfectly uniform force on it during the whole revolution. When driven by gearing without a fly-wheel there is no "back lash" in the wheels. The steam can be cut off at a very early part of the stroke without affecting the regularity of the driving force, and although the speed of the piston or the disk rings is but 200 feet per minute, the engine makes three times as many revolutions in that time as the common engine. It is suggested that this principle could be applied to driving the screw-propeller direct, as it is only necessary that the engine shaft should be extended through the vessel, and have the propeller attached to it. Could this be effected, those vessels which cannot spare much room could advantageously adopt the screw-propeller.

INVENTION FOR STOPPING STEAM-ENGINES.

A correspondent of a London journal gives an account of his visit to a manufactory in Southgate, where he saw in operation a machine for the almost instantaneous stopping of steam-engines. He says,—"We were taken to the end of the spinning-room, when the whole machinery, driven by an engine of 30 horse-power, was in full operation. At a signal, a valve was opened that admitted the atmospheric air, which instantly choked the condenser of the engine, shut off the throttle and water valves, and opened the blow-valves. After this was done, the fly wheel made only one revolution and a quarter, while ordinarily it makes five before it can be brought to a stand. Notwithstanding the suddenness of the stoppage not a single thread was broken. This piece of machinery, which may be called a safety-valve, may be put at any distance, and by means of pipes, it will operate in the same manner as if it were close at hand. The value of this must be seen when we consider the frequent cases where persons are caught in the mill-straps and drawn up over the shaft, whereby they are destroyed; but by this invention the whole machinery may be stopped before they could come in contact with the shaft." The expense of putting up the apparatus amounts to about three dollars for each horse-power.

STEAM HOISTING MACHINE.

THIS machine is intended to be applied to the loading and discharging of cargoes from vessels, and has been so used for some time by a stevedore of Philadelphia. The motion of the engine is communicated to a fly-wheel shaft, which carries a small pinion gearing into a large wheel. The winding barrel to which this hoisting-rope is attached is locked to the shaft of the large wheel by means of a driving friction coupling, which is thrown into or out of motion by a lever; and the motion of the drum when free from the shaft of the wheel is controlled by a friction-band, which is tightened or slackened by a brake. The machine requires but one person to attend to it, and is capable of hoisting twelve hogsheads of tobacco from the hold of a vessel, and turning them out on the wharf, in ten minutes, or it can discharge three hundred bales of cotton per hour. In case the article being raised should strike on the combings of the hatchway, the engineer has only to slacken the brake, and it is lowered without stopping the engine, so as to clear the obstruction, and then by tightening the brake again the ascending motion is restored. In lowering, the articles can be stopped at any point with great ease. The machine is on wheels, and can be moved from place to place by a single horse.—*Journal of Franklin Institute for September.*

EXTRAORDINARY SPEED.

A NEW locomotive has lately been placed on the York and Newcastle Railroad, whose performance, both with regard to speed and to power, surpasses all previous experiments. It regularly runs 45 miles in 40 minutes with a train of cars, and it is computed that as soon as the new rails are laid down the distance will be accomplished with ease in half an hour, that is, at the surprising rate of 90 miles an hour. The velocity, although the greatest yet attained, is accomplished with an entire freedom from that apparent oscillating and undulating motion which characterizes outside-cylinder engines. Its arrangements are entirely new; the top of the boiler, which is four feet in diameter, being only seven feet nine inches above the rails. The cylinders are 16 inches in diameter; the stroke of the piston is 20 inches; the driving-wheels, are 6½ feet, and the carrying-wheels 4 feet in diameter, and are entirely of wrought iron. The eccentrics and gearing also being outside of the wheels, render the whole engine compact, simple, and easy of access.—*London Mining Journal.*

SAFETY-FUSE FOR BOILERS.

MR. A. STILLMAN, of the New York Novelty Iron-Works, has patented an invention for indicating the lowness of water in steam-boilers, which is said to have proved very satisfactory, after several trials. One or more tubes are passed through the upper surface of the boiler, reaching down to the top of the flues, or fire-tubes; they are about an inch in diameter inside, and are fastened securely down by a screw-

nut. At the bottom end the orifice is much contracted, so that any fluid entering can easily ascend in the larger portion. On this small orifice is placed a cap of soft metal, fusible at a low temperature, and the tube being screwed tight down compresses this fusible cap against the top of the flue. Now, as long as the cap remains at 212°, the temperature of the boiling water, it will keep its place; but if the supply of water fails, so that the surface of it in the boiler gets below the cap, the flue becomes red-hot, and the fusible metal melting off from the small tube, the steam instantly rushes out, and thus gives notice to the engineer. More water is of course then let into the boiler, and the pipes are stopped with plugs of wood till at the first opportunity, when the steam is down, a new cap is screwed on. It would seem, therefore, that though this may answer for one occasion, yet if the water gets too low twice during the same trip, the boiler may be blown up without any warning being given of the want of water.

PATENT STEAM AND WATER GAGE.

These different gages are the invention of Mr. A. S. Lyman, of St. Louis, and may be separately described, though intended to go together. The steam-gage consists of an iron tube, of any length, which is attached at one end to the top of the boiler, while the other is curved in the form of an inverted siphon; connected with this is a strong glass tube, sealed at the top, and placed in an upright position beside a scale graduated to show the number of pounds of steam in the boiler to the inch. The longer leg of the siphon is in part filled with mercury, above which is a column of water to protect it from the heat of the steam, which is forced from the boiler through the iron tube until it comes in contact with the water. The pressure of the steam on the water compresses the air in the glass tube, so that double the pressure drives the air into nearly half the space. The correctness of the gage depends on the fact that the water is a good non-conductor, and cannot transmit heat downwards. Air is expanded by being heated, and it requires a greater pressure to force it into a given space when warm than when cold. Eight degrees of temperature make a difference of a pound in the indication of the gage, and it is for this reason that the thermometer is added, and the scale is made when the mercury stands at 72 degrees. At this temperature the scale is strictly correct, but for every 8 degrees more or less you add or subtract one pound.

The water-gage is constructed in the same way as the steam-gage, except that, instead of being connected with the top of the boiler, it is connected with a copper box, hermetically sealed, lying in the boiler and on the flue. This box is filled with water, so saturated with salt as to prevent freezing, and it has no outlet except through the water-gage. The indications of this gage vary from those of the steam-gage for several reasons, the principal of which is that more heat is required to produce a given pressure from salt than from fresh water. As soon as the water falls too low, or leaves the surface of the flues bare, they receive extra heat, and so the pressure in the

copper box will rapidly increase. This increase will be indicated by the water-gage, and notice will be given before the extra heat becomes dangerous. The safety-valve can then be raised, so as to let off some of the steam, which will cause the water to foam up and cool the surface of the flues, and if the alarm is attended to in time there will be no danger in this. But if it is neglected, the only safe way is to partially extinguish the fires and start the pumps.

The steam-gages are so constructed that, if any more air is introduced than there was before the scale was made, the extra quantity will escape the first time the steam is down; and the scales cannot be slid upwards so as to make them indicate less than the true pressure, for this would be at once detected by comparison with the stuffing-boxes that hold the glass tubes. The only methods of interfering with the correctness of the water-gage would be by cutting a hole in the box on the flue, thus letting the water out into the boiler, or by fastening down the alarm-valves. If the former were done, the vibrations of mercury in the two gages would correspond, and so indicate that something was wrong. If the valve were fastened down, the iron tube would burst open, and this must take place before the flues were heated to 450°, and as it requires 1,000° to produce a red heat, timely warning of this would be given. There are several other guards against all possible derangements of this very ingenious invention, which is the best preventive of explosions we have yet seen.—*Scientific American.*

NEW ROTARY ENGINE.

SEVERAL trials have been made, as we learn from the *London Times*, with a rotary engine, which has been brought to its present working condition by Hon. W. E. Fitzmaurice. The engine is very simple, merely consisting of two pieces so mathematically arranged that the interior part works in the outer with the greatest ease, being free from dead points and without the slightest vibration, however great the velocity. It has no springs or packing, and the parts meet each other so harmoniously as only to give a humming noise like a spinning top, and it is not in the least liable to get out of order, the wear being perfectly uniform throughout. The entire motion being a rolling instead of a cutting one, the engine will last long without repair, as the surface becomes case-hardened in a very short space of time. The trials took place in the presence of several scientific gentlemen and engineers of eminence in their profession, in a frigate's pinnace, the engine being constructed for the government. The boat is of 10 tons burden, carrying a load of 5½ tons, and drawing 4 feet of water. She is 32 feet long and 8 feet breadth of beam, made for carrying men and carronades, but not in any way calculated for speed, and yet the engine of 10 horse-power, occupying a space of 21 inches by 7 inches, drove a screw-propeller of 3 feet in diameter and 4 feet pitch with such velocity as to make 200 revolutions in a minute, the motion being given on the direct-action principle. Although the boat was not at all calculated for speed, she was propelled against the

stream a distance of 2 miles in 20 minutes, equal, allowing for the strength of the current, to 8 miles an hour. The engine weighs considerably less than 1 cwt. to each horse-power, and requires much less fuel than the ordinary engines, and is so easily set in motion, graduated to any velocity, or stopped, that a boy of 12 years of age might manage it with one hand. The best judges have pronounced a high opinion of its capabilities, after witnessing its performances. Captain Fitzmaurice makes no secret of the invention, but shows its interior freely, as it is intended for the public service. An engine of 100 horse-power on Captain Fitzmaurice's construction would only occupy a space of 4 feet by 2 feet.

HIGH-PRESSURE STEAM IN MARINE ENGINES.

In answer to some questions from the Admiralty, with reference to the employment of high-pressure steam, working expansively in marine engines, Mr. J. Seaward has submitted a long paper, which closes as follows:—"The highest pressure of steam that we have in any case put upon a marine boiler of our own construction, was about 16lbs. to the square inch; but we are not inclined to repeat the experiment, as we feel assured that we can obtain equally good results with steam of a lower pressure. From 10 to 12lbs. is the usual pressure we employ in the merchant service for engines and boilers of comparative small power. The steam pressure at present employed in the service is about 8lbs. per square inch. We consider steam of this pressure to be well adapted for the exigencies of the service; we believe it is calculated to secure all the important advantages of power, and economy of weight and space, in a very eminent degree; these advantages will, in some respects, be slightly increased by augmenting the steam pressure to 10 or 12lbs. to the square inch. We strongly recommend that the steam employed in the navy should not be of greater pressure than 10, or in extreme cases, 12lbs.; any material increase to the latter pressure will be attended with considerable risk without any adequate advantage." These remarks do not apply to the use of high-pressure *non*-condensing engines.—*London Athenæum.*

THE CHLOROFORM STEAM-ENGINE.

The "Combined Vapor Engine," as it is called, on the principle of M. du Tremblay, a French inventor, is now attracting the attention of London mechanics and *savans*. The engine was originally brought out in Paris, in 1846; subsequently the French government had one constructed, and appointed commissioners to experiment as to its value. The commissioners made a report, in which they stated that the power of the steam-engine was more than doubled by the addition of M. du Tremblay's apparatus, without any additional fuel being required. The invention, it appears, is applied "either to a single engine with two cylinders and pistons, or, as is usual for maritime purposes, to two distinct engines with a cylinder and piston each." ʻhe engine exhibited a small pipe is attached from a boiler, by which

one of the pistons is acted upon by steam, as in the ordinary steam-engine. Upon the escape of the steam from the first cylinder in which it so acts upon the piston, it is received in an air-tight case, termed a vaporizer, in which there are a number of small copper tubes filled with chloroform. Upon the steam coming in contact with the tubes the chloroform becomes vaporized, and works the other cylinder, while the steam is condensed and returns into the boiler, as warm water, to regenerate fresh stream, or motive power. In the meantime, the chloroform, after exerting its force upon the second cylinder, is, in its turn, condensed, and, by means of a force-pump, returned to the vaporizer, which is thus kept regularly supplied, the chloroform being alternately vaporized and condensed. In addition to the advantage of giving greater power to engines than by the ordinary steam process, the vapor being nearly as 1½ to 1 more powerful than steam, it is stated that a saving of nearly 50 per cent. is effected in fuel. M. du Tremblay originally used ether as his vaporizing agent, but at the suggestion of M. Arago, he has substituted chloroform, which, although it does not vaporize at quite so low a temperature as ether, has the advantage of being perfectly incombustible and inexplosive, thus removing an objection which was made to the invention as originally brought out, of the inflammable nature of the liquid used. One of M. du Tremblay's engines, of 35 horse-power, has been constantly at work for 14 hours a day at a glass manufactory in Lyons for more than 12 months, during which time the liquid used has been ether, without any accident or disarrangement of the machinery having occurred.

A NEW MOTIVE POWER.

We find in the *London Mining Journal* a long letter from Count de Wardinsky, who claims to have discovered a new motive power, whose force far surpasses that of steam or any other known power. He says,—"If we employ one cubic inch of this new ingredient, we obtain from it a pressure of forty-six tons to the square inch of surface. The gases evolved consist chiefly of carbonic oxide and carbonic acid gas, which are both permanently elastic, so that in passing through cold air or water they do not collapse, but will follow the piston to the utmost limit of its work. In using this ingredient we require neither fire nor water; it creates neither smoke nor any offensive effluvia, and leaves no residuum except a slight moisture. Neither is there any compound in the gases which could corrode metals, as was assumed by Teschemacher and others, who supposed that there might be compounds of cyanogen in the gases of this ingredient, judging from the color of the flame when such gases are ignited, never once telling us that the greatest portion is carbonic oxide, which is well known to burn with a dark blue flame. The ingredient in question consists, in fact, of all kinds of vegetable fibres, such as cotton, flax, hemp, tow, &c., rendered explosive by being dipped for 15 minutes in nitric acid, strengthened by the admixture of an equal quantity of sulphuric acid, after which they are well washed in pure

water and dried for two hours." The fact that these fibres thus become explosive was first noticed by Professor Otto, about fourteen years ago, but it was not fully explained and brought to public notice till 1845. It is the substance called gun-cotton by Professor Schönbein, and xyloidine by M. Pelouz. Considering the very intense power of xyloidine, it is the most easily controlled substance we know of, as by compression its explosion can be retarded or wholly prevented. For an engine of two-horse power, a thread of this ingredient, not larger than sewing-cotton, is sufficient, so very explosive is it, and the Count expects that it will cause steam-engines to become obsolete, as he thinks he can successfully apply his new discovery to all manners of locomotion, &c.

THE STEAMBOAT NEW WORLD.

EVERY year sees some new steamboat constructed which surpasses in size, magnificence, or speed those previously made. There is no doubt that the mechanics of this country excel those of any other in their inland steamboats, and it is also probable that in a few years the same can be said of our sea-going steamships, though it must be allowed that those hitherto produced are, with few exceptions, decided failures. During the present year, the new steamboat New World has commenced running. She is said to be the longest boat ever put on the stocks in this country, and the longest afloat in the world. Her length is 373 feet; extreme width, 69 feet; the engine is 76 inches in cylinder, 15 feet in stroke, and the wheels, of iron, 46 feet in diameter. She draws 4½ feet of water. The engine is a low pressure one, and though the boat is so very long she obeys the helm with great readiness. Her decorations are all of the most superb and costly character.

[If we ever attain any greater speed either in our inland or seagoing steam-vessels, it will be principally by enlarging their size. Though some improvements will doubtless be made in the engines and in the models of the vessels, yet the great gain will be by increasing the tonnage, for the reason that the size, and consequent room for engines and coal, increases much faster than does the opposition caused by the water and the air.—*Editors.*]

ON THE PADDLES OF STEAMERS.

THOMAS EWBANK, ESQ., the present Commissioner of Patents, has communicated to the *Journal of the Franklin Institute* an account of some experiments made on the paddles of steamers, for the purpose of ascertaining the best form and material for them. He thinks that there can be little doubt that the greater the velocity of a steamer's wheels the fewer (within certain limits) should be the blades, and that in many of our boats the number might be advantageously reduced. One blade in the act of plunging, another sweeping under the shaft, and a third leaving the surface, are all that is necessary to

be kept up, and a greater number, as regards the speed of a boat, are positively injurious. In most of our vessels, the paddles are much too numerous, there often being 28 and 32, which are sometimes in a manner split, and thus doubled in number. The Cherokee (Chagres steamer) has six blades below the surface when ready for sea. The Washington has five fully immersed on each side. A boat never progresses in the ratio of the revolutions of the wheels, because of the yielding nature of the medium in which they act. Thus in going from New York to Liverpool, a distance of 3,023 miles, the paddles of the ocean steamers pass over a distance varying from 5,000 to 8,000 miles. This can be in a measure modified by giving the paddles a better hold of the fluid they sweep through, and Mr. Ewbank recommends various forms for them; but the principle in general is, that as the propelling power of the paddle is greatest at its lower or outer extremity, and diminishes to nothing at the surface, so its face should enlarge with the dip and be nothing or very small above. Thus the common forms of paddles are seen to be entirely wrong, and the best form would be triangular, as is the case with the tails of fishes and the webbed feet of the sea-swimming birds. The propelling virtue of blades expands and contracts with their thickness, it being greatest when they are reduced to the thinnest plates consistent with the strains they must oppose, so that metallic plates will probably soon be substituted for the thick wood planks. Again, the sharper the dipping edges of the paddles are made, the more back water they throw off at the point where its departure is most beneficial, so that here again metal has the advantage. The sharp edges in paddles are similar in their nature to the mere film which forms the tails of fishes.

It has been usual to assert that the thicker the paddles the better, because they do no harm, and add to the weight of the wheels, so as to make their motions more uniform; and acting on this view, our steamers have had their paddles made of plank from 1½ to 3 inches in thickness. In the Cunard steamers they are 2½ inches, in the Franklin, of the Bremen line, 2½, and in others, such as the Atlantic and Pacific, of the Collins (Liverpool) line, they are to be 3 inches. In the Atlantic, the paddles, if united, would form a solid mass 7 feet thick, equal to one fifth of the diameter of the wheel. They are to be 12½ feet long by 34 inches, so that they contain nearly 500 cubic feet of timber, and at every revolution they must displace this enormous body of water by their submersion alone, not only uselessly, but with a serious retardation of the vessel's headway. In the Pacific, the loss is even greater, and in every revolution of each wheel her paddles will lose 7½ feet of effective stroke, to the 7 feet loss of the Atlantic. In like manner, the loss in the wheels of the United States is from 10 to 15 feet of the effective stroke in every revolution. It can easily be seen what a saving would be effected by using ½-inch iron instead of 3-inch plank. Plates of steel are the best material, combining strength and thinness. A great loss in the power of the paddles is caused by having projections, such as bolts, nuts, stays, &c., on their faces. If any material could be found which would durably prevent the paddles from becoming wetted, they would

carry over less water, and here also there would be a saving of power or a gain in speed. The above results, obtained by Mr. Ewbank, are very surprising, and it is to be hoped that our mechanics, in their striving after a six days' passage across the Atlantic, will not overlook his suggestions.

NEW VERTICAL-DIPPING PADDLE-WHEEL.

Mr. John Mills, Jr., of Springfield, Mass., has invented a new paddle-wheel, which so operates the paddles as to make them dip vertically in the water, and then leave it in a vertical position. The paddles therefore move on axles, and are allowed by their own gravity to swing free while not in the water, but at the moment they enter the water vertically, (which they will do on a perpendicular line with the centre of gravity), a stout arm on each side grasps the outer side of the paddle and holds it firm while it is passing through the water, and then releases it, so as not to raise any back water. These stout arms to do this are secured on the radial arms of the wheel, and are operated by having their ends revolve in a groove of a stationary eccentric cam, secured around the shaft of the wheel. The groove in the cam guides the arms that grasp and retain the paddles, to catch and let go the paddles at the exact point required.—*Scientific American.*

LARGE WATER-WHEEL.

A large wheel has been manufactured at the Union Works at Paterson, for Don Rubio, capitalist and manufacturer in Mexico, for his factory at Queretaro. It measures 66 feet in diameter, or 200 feet in circumference, being the largest wheel in the world, except one in Scotland. It has 169 buckets, 9 feet long, and its weight, including the cog-wheels for regulating the speed, is near 200 tons! It will make two entire revolutions per minute, and its power is that of 100 horses.

NEW PADDLE-WHEEL.

The wheel is the invention of a Mr. Tingle, of New York. The paddles are of sheet-iron, and instead of being fixed at right angles to the arms of the wheels, consist of two parallel plates vertical to the water, and so contrived, that when the paddle enters the water it assumes the form of a bucket, or of the covers of a book open at an angle of 40 degrees; the plates move upon a pivot, and as the paddle rises from the water, the plates again become parallel, and the water escapes.

The advantage of this wheel is, that the power is effectually exerted at the right point, and that it lifts no water when rising, which is the great objection to the ordinary paddle-wheel. A trial has been made which was quite satisfactory. The wheels were properly adapted to a boat 32 feet long, and worked by two men, with a crank and band.

With a company of twelve persons, the passage from Hoboken to Jersey City was made in eighteen minutes, against wind and tide. The wheels are 5 feet in diameter.

A NOVELTY IN STEAM NAVIGATION.

MESSRS. STEVENS, of Philadelphia, have built a steamboat on a new model, which may perhaps be best described by giving their specification of claim in applying for a patent.

"What we claim as our invention is applying air to the immersed surface of a vessel in motion, as described, and thus we interpose, by a continuous or intermittent supply, a stratum of air between the immersed surface or portions thereof, of the vessel and the water, for the purpose of reducing the friction of the water. We also claim the recesses on the immersed surface of the vessel, formed by the scales or other irregularities, or any thing substantially the same, when combined with the supplying of air, for the purpose of distributing the air, and for retaining it more perfectly and for a longer time between the surface of the vessel and the water; but it is to be understood that we do not claim those recesses independently of their connection with the use of air to reduce friction. We also claim the plates over the air apertures, to reduce the pressure required for the discharge of the air, but this we claim only when air is used as a means of reducing friction. We also claim the apertures made in the stern of a vessel, communicating with the atmosphere by pipes or other conductors, for the purpose of diminishing that resistance produced by the motion of the vessel from the motion of the water, commonly called the suction of the stern; we do not claim the use of these apertures excepting in connection with paddle-wheels, screws, or other propelling agent."

NEW ENGLISH IRON STEAM-FRIGATE.

WE copy from a London journal an interesting account of a new steam-frigate, recently constructed for the British navy. Her length from the figure-head to the taffrail is 270 feet, while that of the keel is 221 feet 4 inches; her greatest breadth is 41 feet, and the depth 29; the tonnage is 1,979 tons. She is called the Simoom, and is provided with a screw-propeller of 16 feet in diameter, which is driven by two engines of 350 horse-power, which are placed below the surface of the water, in order that they may be protected from shot in time of action. The manner in which she is built, with reference to strength, is somewhat peculiar. The keel and stem are of solid iron bars, 9 inches deep by 5 thick, and the stem is of one piece of this breadth and thickness, and upwards of 40 feet in length. The stern-posts are of iron of the largest size, and the frames are of large-sized angle-iron and are placed at short distances apart; the floor-pieces at the bottom of the frames are 2 feet deep. On the top of the floors there is a large box keelson, formed of iron, extending fore and aft the ship. The outside plates or skin of the ship are one inch in thickness

at the bottom, diminishing to three quarters of an inch at the top of the side. The main and spar decks are four inches thick, laid on iron beams of large dimensions, to which are connected large iron shelf-pieces and stringers, with water-ways formed of timber extending all round the decks, and connected with the sides of the ship. The armament for the spar deck will be two swivel guns of 112 cwt. each, and four of 56 cwt., all for firing shot or shell of eight inches diameter; there are also two 32-pounders of 25 cwt. each. For the main deck there are twelve 32-pounders of 56 cwt. each. The screw-propeller is so fitted that it can be disconnected from the engines and raised on deck through a trunk fitted through the decks for that purpose.

This is in point of tonnage the largest iron frigate ever built, and the largest ship of that material ever launched, for it must be remembered that the leviathan, the Great Britain, was not launched, but floated into the water.

THE NEW UNITED STATES STEAMER SUSQUEHANNA.

The United States steamship Susquehanna, at Philadelphia, will be ready for launching early in the spring. She is thirty feet longer than the great ship of the line, the Pennsylvania. Her breadth of beam is much less, and her tonnage is but 2,500. She will carry but eight guns, of heavy calibre; one of them, which will be placed upon her bow, will throw hollow shot weighing 268 pounds. Her machinery will cost $300,000, the four boilers alone $30,000 each, and the whole vessel, when completed, about $600,000. Her crew will consist of about 300 men.—*Journal of Commerce.*

GREAT RUSSIAN RAILWAY FROM ST. PETERSBURG TO MOSCOW.

The greatest work of modern times, undertaken as a public improvement, and not directly as a war measure, was the project by the Emperor Nicholas of Russia for a line of railway to connect the great capitals of the empire. The distance was generally stated at 500 miles, but the location of the railway has been effected in a distance of only 420 miles. The plan adopted contemplated the construction of a road perfect in all its parts, and equipped to its utmost necessity, regardless of expense or of the time requisite to its completion. The estimates were on a scale of imperial grandeur, and contemplated the expenditure of *thirty-eight millions of dollars.* The work was intrusted to Col. George W. Whistler, with unlimited authority, and *forty millions of dollars* were set aside for the work. Seven years was the shortest estimate made for the time of its completion, and all parts of the work were so distributed as to give time for everything to take its appropriate position when required. These advantages were fully appreciated by Col. Whistler, and all his plans were matured upon a scale of comprehensive economy suited to so important an undertaking. The line selected for the route had no reference to intermediate localities, and is the shortest one attainable without

sacrificing more valuable requirements for the road. It is nearly straight, and passes over so level a country as to encounter no obstacles requiring a grade exceeding *twenty feet* to the mile, and most of the distance is upon a level. The road-way taken is *four hundred feet* in width throughout the entire length; the road-bed is elevated from six to ten feet above the ordinary level of the country, and is thirty feet wide on the top. The road is laid with a double track, a five-feet gage, and a rail of sixty-nine pounds to the lineal yard, on a ballasting of gravel two feet in depth. The bridges have no spans exceeding *two hundred feet*, and are of wood, built after the plan of "*Howe's Improved Patent*," so well known on the New England roads, with a truss twenty-four feet in depth. The work had so far advanced at the time of Col. Whistler's death, that a large portion of it will be in use the present year, unless this event shall delay the prosecution of the work. Under these circumstances, the death of Col. W. was received in this country with a universal expression of sympathy and sorrow. It is fortunate, however, that the enterprise is so far completed that his fame and his works are safe from the accidents of time or of change. His successor will share largely in the same American spirit that he possessed, and will see no reason to change or modify anything that had been attempted by a man who united to the rarest mechanical genius the most eminent practical ability.

We have derived from Mr. W. L. Winans, who has recently arrived from Russia, some particulars with reference to the equipment of this road. Mr. Winans is one of three American gentlemen, who have the contract for equipping the road. They have already supplied it with 162 locomotive engines, averaging 25 tons' weight; 72 passenger cars; 2,580 freight cars; and 2 imperial saloon carriages, capable of carrying the Imperial Court of Russia. This equipment has been built in Russia, in shops furnished by the government, and supplied with Russian labor, with a few American mechanics to oversee the work. The whole contract with Messrs. Harrison, Winans & Eastwick has amounted to between 4,000,000 and 5,000,000 dollars. They engage to instruct Russian mechanics to take charge of the engines when completed.

The engines are of two classes; 62 are 8-wheel engines for passenger travel, and 100 8-wheel engines for freight. The passenger engines are of one uniform pattern throughout, so that any part of a machine will fit the same position on any other. They have each 4 driving-wheels, coupled 6 feet in diameter, and trucks in front similar to the engines on the New England roads. Their general dimensions are as follows:—Waste of boiler, 47 inches; length of tubes, 10½ feet; number of tubes, 186; diameter of tubes, 2 inches; diameter of cylinders, 16 inches; length of stroke, 22 inches. The freight engines have the same capacity of boiler, the same number and length of tubes, with 3 pair of driving-wheels and a pair of small wheels in front. The driving-wheels are only 4½ feet diameter, with 18-inch cylinders, and 22-inch stroke, all uniform throughout in workmanship and finish.

The passenger cars have the same uniformity. They are all 56

feet in length by 9½ feet in width, and divided into three classes, the first class carrying 33 passengers, the second class 54, and the third class 80 passengers each. They are all provided with 8 truck-wheels each, with elliptic steel springs. The freight cars are all of them 30 by 9½ feet, made in a uniform manner, having 8 wheel-trucks under each. The imperial saloon carriages are 80 feet in length and 9½ feet in width, having double trucks with 16 wheels under each. They are finished into *five* different compartments, the imperial mansion in the centre, 25 feet in length, fitted up with every luxury for sitting or reclining, and with every comfort that the most ingenious mind can devise, or the most refined taste can desire. Spacious platforms are provided in front and rear. The whole cost of them exceeds $15,000 each. The depots at each terminus, and the station-houses and engine-houses along the line, are on a plan uniform throughout, and on a scale equally imposing. Fuel and water stations are placed at suitable points. Engine-houses are provided at the distance of 50 miles apart, built of the most substantial masonry, of circular form, 180 feet in diameter, surmounted with a dome, containing stalls for 22 engines each. Engines are to run from one engine-house to another only under one heat, and are run back and forth from station to station, so that they are kept constantly in charge of the same persons. Repair-shops are attached to every engine-house, furnished with every tool or implement that the wants of the road can require. Engine-drivers have to go through the appropriate training before they are allowed to take charge of an engine, and every arrangement provided that skill, experience, or ingenuity can demand.—*American Railroad Journal.*

We may perhaps be allowed to add, that the contract price for the engines was a little over $9,000 each; and if the contractors were not obliged to pay a duty on the steel imported, they could send engines to England at a profit. The cars are of the same kind as our American cars, thus differing from any others in Europe. When the question between the short English and the long American cars was brought up in the Council on Railroads, Col. Whistler stated his opinion, which was violently opposed by every one, but the Emperor cut short the discussion by telling Col. W. to do as he chose.—*Editors.*

NEW LOCOMOTIVE.

One of a new kind of locomotive, for burning anthracite coal, has recently been placed upon the Boston and Worcester Railroad. It is invented and manufactured by Mr. Ross Winans of Baltimore.

The engine, which is named the "Carroll of Carrollton," is of 28 tons' weight, with 2 driving-wheels, 7 feet in diameter, and 8 supporting or truck wheels, the driving-wheels being in the centre. It is constructed for burning anthracite coal, and has a fire-box 6 feet in length, 3½ in width, and about 2 feet in depth, which will contain at least a ton of coal. The fire-grate is composed of stout, separate bars, so arranged as to permit the firemen to turn them and shake out the ashes, even when the doors of the fire-box are closed.

Another and material improvement has been attempted in the con-

struction of this engine, by which the pressure or tractive power of the driving-wheels may be increased or reduced, as the grades or other circumstances may require; in other words, the weight of the machine may be distributed so as to fall equally upon all the wheels. The adhesive power of the drivers may thus be graduated from 6,000 to 25,000 pounds. Where the maximum of traction is required, as in starting a heavy train, or in ascending a steep grade, the whole power of the machine may be made available; while on a level or descending grade, the pressure or weight of the engine may be reduced or distributed over all the truck or supporting wheels. It is obvious that if the traction can be thus varied and adapted to circumstances, a great saving may be effected in the wear and tear of the rails. Whether any difficulty will arise from concentrating the pressure upon a single point, as must necessarily be the case when it is mainly applied to the two driving wheels, experience must determine. We understand that the idea is new with Mr. Winans, and that he has patented the improvement, as well in Europe as in this country.

The qualities of the engine were tried with a single car only, to Worcester and back. It is calculated for great speed, but no attempt was made to test its capabilities in this respect, although for a short distance a speed of 60 miles an hour was attained. As far as can be judged from a short experience, the machine has realized all that was desired from it. The use of anthracite coal in locomotives, if it can be successfully effected, will be a great improvement, in respect to convenience as well as economy. It is calculated that in this engine one ton of coal will be equivalent to two cords of wood.—*Boston Traveller.*

STEAM-CARRIAGES ON COMMON ROADS.

We find in a late number of the *London Railroad Gazette*, a communication on the subject of the use of steam as a propelling power on common roads. The writer says that it is agreed that steam-carriages on common roads are perfectly practicable and safe, and he cites several Parliamentary reports which prove them to be so. The only difficulty has been the liability of the carriages to get out of order, and the great cost of repairing them. A Scotch gentleman, after 30 years' study, and the expenditure of a large sum of money, has, it is said, succeeded in perfecting a steam-carriage, which will remove every difficulty hitherto met with. The improvements claimed are in "condensing the steam and using distilled water," "in working the steam expansively to its utmost power," "in preventing all loss of heat from radiation," "in suspending the carriages and machinery on springs," "in applying elastic wheels to prevent shocks," "in the mode of working the engines at their maximum speed," "in preventing the slipping of the driving-band and lateral friction from the journal of the wheels," "in using common coal as fuel and consuming the smoke," "and in reducing the expense of working by dispensing with water-stations along the road." No doubt is entertained of the entire success of this new steam-carriage, and long and seemingly conclusive

reasons are given for its superiority over other machines of the same sort. It can be worked for about a quarter of the expense of railways, though of course not at so great a speed as is attained on the latter.

IMPROVEMENTS IN LOCOMOTIVES.

THE *London Mechanics' Magazine* describes some newly patented improvements in locomotive engines and in marine and stationary engines. They consist, 1st, in converting reciprocating rectilineal motion into rotary motion; and 2d, in converting rotary motion into reciprocating rectilineal motion. 1. Upon the revolving shaft is fixed at right angles a lever, to the other end of which, and on one side, is attached a small rectangular block. On that side of the lever which carries the block is a square metal plate containing two slots, one horizontal and the other vertical, which intersect at right angles in the centre of the plates. The revolving shaft passes through the vertical slot, so that the plate may travel freely up and down over it. The block (which is somewhat longer than the breadth of the vertical slot) is placed in the horizontal slot. Supposing the lever to be upright, slightly deviating from the perpendicular, which is parallel to the vertical slot, and that a downward motion is communicated from a steam-engine to the plate, to the full extent of the vertical slot, the result will be that the block will travel from the centre to the end of the horizontal slot, that the lever will assume a position the reverse of the one in which it was first placed, and that the main shaft will have made half of an entire revolution. The dead centre is then overcome by a fly-wheel, and an upward motion given to the plate, whereby the revolution of the main shaft is completed, and the lever brought back to the first position ready for the second operation.

2. The arrangements for converting rotary motion into reciprocal rectilineal motion are the reverse of those above described. When the rotary motion is to be communicated to the end of a crank-shaft or crank-pin upon a wheel, the vertical slot may be dispensed with, and the horizontal one only used, or a groove may be substituted for the slot.

IMPROVED LOCOMOTIVE BOILERS.

AT the meeting of the Institution of Mechanical Engineers in London, on July 25th, Mr. Ramsbottom, of Manchester, read a paper "On an Improved Locomotive Boiler." He began with some introductory observations on the fact, that the absolute power of the locomotive is directly proportioned to the quantity of steam which the boiler can produce in a given time. All recent improvements in boilers have been tending to obtain a greater amount of heating surface without increasing the length or diameter of the boiler, or making it oval. To effect this object the author proposes to construct a copper fire-box with an arched roof, whose top would be nearly as high as the cylindrical part of the boiler. With such a box the whole of the

cylindrical part of the boiler could be filled with tubes, as the longitudinal stays could be removed. By this arrangement 225 tubes, of 2 inches external diameter, could be used, the shell being 3 feet 8 inches in diameter and 10 feet long. The total heating surface of the fire-box is 80 feet, and of the tubes 1,177. This arrangement involves the necessity of keeping the boiler full of water, and it then becomes necessary to provide a separate steam-chamber. This consists of a cylinder 18 feet long and 20 inches in diameter, fixed over and parallel to the cylindrical part of the boiler. This tube has a cubic capacity of 28½ feet, and has two communications with the boiler; it is proposed that the water shall occupy about one fourth of the tube, leaving the remaining 21 cubic feet for steam. Some discussion took place upon this plan, and it was objected that there would be a tendency to "prime" in such a boiler, but it was also suggested that this might be remedied by having a more continuous communication between the generator and the cylinder.

ANTHRACITE COAL IN LOCOMOTIVE ENGINES.

Mr. George W. Whistler, a son of the late distinguished engineer, has made a very valuable report on the use of anthracite coal in locomotives, containing the results of experiments and observations made by him on the different kinds of fuel in three different varieties of locomotives on the Reading, Pa., Railroad. The three locomotives were an anthracite coal one, built by Ross Winans of Baltimore, a condensing engine, the Novelty, also burning anthracite coal, and the ordinary wood engine. He records 17 trips of the Baltimore coal engine, 5 of the Novelty, and 3 of the wood-burning engine; the quantity of fuel reckoned as consumed is always the difference between that taken at one end of the road and that remaining at the other. The Baltimore engines, in their 17 trips from Richmond to Pottsville, and *vice versâ*, consumed 79.9 tons of coal, equal to an average of 4.45 tons per trip up, and 4.95 tons per trip down, or 9.4 for the round trip. The average load down was 90 cars, with 450 tons of coal. The coal used was the "Forest Improvement," much of which is fine, with dirt intermixed, so that the waste amounts to about half a ton per trip; but Mr. W. deducts 5 per cent. from the gross weight, which leaves exactly 76 tons for the 17 trips, and 9 tons for each round trip. The Novelty condensing engine consumed in 5 trips 28.1 tons, equal to 5.62 tons for every up trip, 5.63 for the down one, and 11.25 for the round trip, or, deducting 5 per cent. 10.7 tons for the round trip. The average load down was 75 cars, with 375 tons of coal. The Indiana wood engine consumed 7 cords for every up trip, and 7.37 for the down one, making the wood used per round trip 14.37 cords. The average load down was 88 cars, with 440 tons of coal. The return load was always about one-third of the gross weight of the train brought down. Wood costs $4 per cord, and coal $2.75 per ton of 2,240 pounds. Mr. Whistler, who is perhaps somewhat prejudiced, says of the Novelty engine, "I could but agree in the opinion generally entertained and expressed, of its entire impracticability."

The expense for repairs in the coal-burning engines is considerably more than that for the wood-burning ones. This is caused by the rapid burning out of the fire-boxes, grates, &c. When iron (whose soundness is at present always uncertain) was used entirely in the fire-boxes, the intense local heat very soon burned away the sheets near the fire, and also the joinings of the sheets were affected. To obviate this latter difficulty, larger sheets were used, but this only increased the first trouble, and finally copper sheets directly about the fire were resorted to. These, however, do not last long, and the expense for repairs is large. The repairs have hitherto cost about $456 per annum for each engine, but Mr. W. thinks this can be reduced to about $380. If we calculate the price of fuel as stated above, the saving in the coal engines would be as follows, allowing for 100 round trips per annum:—wood engine each trip costs $57.48; coal $25.85; the excess of cost of wood per annum is $3,163; deducting extra repairs, we have $2,787 as the actual saving in the Baltimore engines.

These engines being on a new plan, and burning a new fuel, labor under great disadvantages, having no previous experience to guide them; but there can be little doubt that in a few years anthracite coal will be used as fuel in locomotives on many of our railroads with a saving over wood.

TYLER'S SAFETY-SWITCH.

THIS switch, the invention of Mr. P. B. Tyler, of Springfield, Mass., possesses all the good qualities of the old gate-switch, and has none of its imperfections. It seems fully to accomplish its object of preventing the train from running off the track when the switch is set wrong, either by design or accident. The single-rail or gate-switch is established as the best and safest for the ordinary purpose of shifting the cars from one track to another, but it is liable to the serious objection of leaving one track open or broken. Mr. Tyler's improvement removes this evil, and, while it accomplishes this important office, leaves the switch in its original simplicity of a plain, unbroken rail, connecting one track with the other. An important feature in this safety-switch, which distinguishes it from all others designed for the same purpose, is, that the safeguard, or portion intended to protect the switch, is always in position, and requires no action of the train to place it right when it comes upon the open track; thereby avoiding all reliance upon the movement of complicated machinery, which may be displaced by ice, gravel, flaws in the material of which it is made, or any of the known obstructions to such apparatus. It presents no obstacle to the cow-catcher, snow-plough, or scraper, and requires no change in the economy of the road more than the ordinary gate-switch. The exact nature of the switch can probably be best understood by giving a portion of the "claim" made in applying for a patent:—"The principle of this invention consists in constructing the moveable parts of the switch with an additional branch, between which and the true switch there is an inclined plane and a guard on the outside, so

that when the switch is set wrong, the cars cannot run off the track." The safety-switch has been introduced upon the Hartford, New Haven and Springfield, the Boston and Providence, the Boston and Lowell, and other railroads.—*Editors.*

IMPROVED RAILWAY CHAIRS AND SWITCHES.

Both of these improvements are the invention of Mr. Baines, who described them before the Royal Society, where they excited considerable interest. The peculiarity of the chairs consists in an arrangement whereby the joints are prevented from rising or getting out of the line, and the rails from driving forward. To effect these objects, the outer jaw of the chair is made to fit close up to the under side of the head of the rails, but the inner jaw is only of sufficient height to clip the bottom flanch, and the rail is not fixed by a key, but by a square wrought-iron dowel-pin, which passes through a hole in the outer jaw of the chair and a corresponding notch in the end of each rail. This pin has a large flat head, and under the head is placed a wrought-iron plate, 9 inches long, which fits close up to the head of the rail on the inner side, and rests on the chair. A square cotter or wedge is then driven vertically through the outer end of the dowel-pin, which draws the whole firmly up to the outer jaw of the chair. The wrought-iron plate is three quarters of an inch thick in the middle, tapered to the ends, and slightly cambered or arched, and is sprung flat by driving the cotter, which is made long enough to drive through the bottom of the chair into the sleeper, and serve as the spike on the outer side of the chair. A slot is made in the upper part of the cotter, to allow it to be drawn out when required. The pressure of the wheels has no tendency to loosen the fixing of the rails in the chair, as the outer jaw fits close to the head of the rails, while the bottom flanch is firmly clipped by the inner jaw, as we have before mentioned. The dowel-pin does not receive any of the pressure of the wheels, but holds the rails against the outer jaw, and also prevents them from rising at the point and from driving forwards. The effect of the long plate under the head of the dowel-pin is to connect the two rails stiffly together, so as to prevent the working of the joint. Another part of the invention is an intermediate chair, whose jaws are alike, but set obliquely, instead of opposite each other. It is slipped endways on the rail, and then twisted at right angles to it, which causes it to grip it firmly between the jaws. It is held by means of spikes.

The improvement in switches consists principally in making the tongue about half an inch deeper than the rail, so that it may work under it, by which means steadiness is secured. During the discussion which took place, it was stated that an experiment had been tried with the chairs for nearly a year on the Norfolk line, where the whole of the ballast was taken away from the joint-sleeper, and there was then only a slight deflection, so that the trial was entirely satisfactory. —*London Mining Journal.*

CAR-WHEELS.

Mr. Henry Smith has within a short time read before one of the London Societies, at the request of its council, an account of the principle of a new solid wrought-iron wheel of his invention. His method may be briefly described as follows. In the first place, a straight bar of hammered or rolled iron is taken, about 4 inches wide, and long enough to form a hoop of such diameter as is most suitable for the form of the intended wheel. Other pieces of bar iron, laid flat and close together, and cut in lengths to the same circle as the hoop, are then taken to form the base of a "pile." The hoop is next placed upon this foundation, and filled with scrap iron, after which the whole is put into a heating-furnace, and when at the proper heat is hammered to form a mould, the face of the hammer being so recessed as to form an approximation to the shape of one side of the finished wheel, but of a smaller diameter. Two of these moulds are then put together, back to back, heated in a similar way, and hammered between tools of the same form and size as the finished wheel; but these tools embrace only a segment of about one fifth of the whole wheel, and the mould must therefore be turned round during the process. The wheel is then put into an annealing furnace, and planished between tools like those mentioned above. After this, all that is necessary is to bore out the centre. By this method any description of iron or steel can be used for the tire of the wheel, insuring a clean wearing surface and a compound character of fibrous and granulated iron, which it is believed no other wheels afford. One of the wheels was exhibited, and when struck had a remarkably clear, bell-like sound. The hammer used was of 9 tons in weight, and the weight of the wheel is 4½ cwt. Some discussion followed as to whether it would not be better to make the tire a disk, but no conclusion was come to, though all agreed that, independent of the tire, the wheel was a most excellent one, and many thought that the tire could not be changed advantageously.

IMPROVED BUFFERS AND BREAKS.

Mr. John Lane, of Liverpool, has just completed an ingenious arrangement of breaks and buffers for railroad cars, some experiments on which have proved highly satisfactory. The first operation was to show the powerful and immediate effect of the new breaks, or stoppers, which, by a mere pull at a lever-handle, so effectually locked a pair of wheels in each car, that from a high speed they came to an almost instantaneous pause. In the absence of diagrams, we can but state that this break locks simultaneously the wheels of all the carriages that follow the first, by means of an ingenious continuation of the arrangement of piston-rods, springs, and other machinery, all being simple in construction, and therefore not liable to get out of order. The break itself, when in operation, clips around a drum in the middle of the axletree of the two wheels in each car to be stopped. The whole is placed under the car-bodies, and the single operation of pulling the break-handle in front effects the stoppage of every car in the

train, so that there is no overstraining of any one pair of the wheels. The buffer consists of a cylinder and piston working through a stuffing-box, the piston-rod carrying at its terminus the buffer-head. The cylinder is filled with water, and is connected by a small tube with another cylinder, containing air, which is above it. When the buffer strikes any object, the water is forced up into the cylinder, and by the elasticity of the air acted on by the water, the engine and train are arrested without injury, and there is not the least shock on the rebound. A strong bulk-head of timber was fixed in the angle of the wall which formed the terminus of the temporary railway, and the passengers in the cars, after being wheeled along as if they were to be dashed against the wall, received only a gentle shock.—*London Mining Journal.*

NEW COUPLING-CLAMPS.

THE object of this invention is to supersede the present system of attaching and detaching railway cars, and it is called the "double-ratchet clamp." The utility of such an invention will be obvious to every rail-road traveller, when he contrasts it with the present defective method. The links by which the cars are fastened together are so constructed as to prevent any "play" between them, more than that allowed by the buffer-springs, so that the jolting which now takes place at any sudden stop is completely avoided, while the time necessary for coupling and uncoupling is much less than at present, and it is not necessary to go between the cars, thus avoiding all danger. The cramp consists of two trucks, or hoops, connected by what is termed a right and left-handed screw, the peculiarity of which is, that by turning it in one direction the links are drawn closer together, and by turning it in the other they are extended. It is worked by an ingeniously constructed toothed wheel, fixed to the middle of the screw, about which a lever is provided with a click and spring for the purpose of taking hold of the wheel, in which it is allowed to traverse. All the room required for the action of the cramp is about 7 inches for the traversing of the lever, and when being used it is hooked to the side-chains of the car, and by its action the buffers are compressed and the cars drawn closer together; the connecting link is removed or attached with great ease and much saving of time. It is the invention of two gentlemen connected with the Northwestern (England) Railroad, who have therefore had an opportunity of seeing the defects of the present system.

NEW SURVEYING INSTRUMENT.

A COMMITTEE of the Franklin Institute, to whom was referred for examination the new surveying instrument of M. Villeroi, which is intended to give the distances between the stations by means of a single observation through the instrument, without the use of a chain, or any other measuring apparatus, have reported that "it is a valuable addition to our surveying apparatus." The instrument consists of an

ordinary telescope, having attached to its eye-tube at the inner end another tube of equal dimensions, and divided throughout its whole length by a vertical partition. At the end of this tube next the eye-piece is placed a ring containing a bisected lens, the two halves of which are equally inclined on opposite sides of the vertical plane, perpendicular to the axis of the telescope. The eye-tube is itself divided by a vertical diaphragm, which abuts against this system of semi-lenses and is prolonged very nearly to the eye-piece. In adjusting the instrument, these two diaphragms must accurately coincide in the same plane, which is arranged by turning the screw which connects the two tubes. The target-staff has two targets projecting at right angles to it on opposite sides, the lower half of each being colored black, and the upper white. The upper target is stationary, and from its centre line a graduated scale proceeds downwards along the staff as far as is necessary. The lower target slides upon the staff, and carries an index opposite to its centre line, which indicates the degree of graduation to which its position corresponds. When in operation, the rays from the upper target, which fall upon the object-glass, will form an image of the target in the instrument, from which image the rays will strike upon the two inclined lenses, so as to form an image above or one below the axis; unless, however, the inclination of the lenses to the vertical plane perpendicular to the axis be very small, these two images will be too far apart to be both in the field of the instrument at the same time. Suppose only the lower one is visible. The lower target will also produce two images, of which the upper one will be in the field of the instrument, and by sliding the lower target up or down we can find a position in which the images of the two targets coincide, and their central lines then appear as one horizontal line crossing the staff. Now, by the mathematical theory of the refraction of light through lenses, when this is the case the distance between the lines will be so nearly proportional to the distance of the target from the instrument, that the error in assuming it to be really proportional is so small that it may be overlooked, especially as it diminishes with the increase of the distance. The accuracy of this instrument depends upon the care exercised in determining the exact point of coincidence of the two lines, and on the precision in reading the scale. The rapidity with which the work is done is very great, and the committee think that in rocky, bushy, or marshy grounds, it will be of great use, as well as where distances across sheets of water are to be measured.

SELF-DETERMINING VARIATION-COMPASS.

THIS instrument—the invention of J. R. St. John—is the admiration of all our scientific and literary men who have seen its operations, and it received the gold medal of the American Institute last year. It is of the simplest construction, and while it does not interfere with the use of the compass as now practised, it merely gives an addition by which the deflections of the needle, from whatever cause produced, are accurately marked, and the corrections from the true geographical meridian at all times shown by simple inspection.

Captain Eldridge, of the ship Liverpool, carried this compass from New York to Liverpool and back, and it determined the changing variations during the voyage. We understand a stock company with ample capital has been organized (of which Professor James Renwick is President) to bring this invention to the notice of the scientific minds of Great Britain and the Continent as soon as patents are secured for those localities.—*Scientific American.*

IMPROVEMENT IN MUSKETS.

An important improvement in the manufacture of guns has lately been made in Prussia, but the secret is so strictly guarded by the government that it is difficult to ascertain any thing concerning it, though some facts have leaked out. The musket has no lock, and is loaded at the stock end of the barrel. The ball is long, cone-shaped, and rounded at the larger end, while the barrel is slightly rifled; but the grooves are perfectly straight, and not spiral, as is the case in our guns. By this means, much of the force of the powder, which is usually expended in giving the ball a rotary motion, is saved, and the ball is consequently thrown to a much greater distance. Indeed, it is said that with half the charge used in a percussion musket, it will carry the ball to the mark at a distance of 900 yards. The fire is communicated from the side of the barrel, instead of from the breech, and this is accomplished in the following manner. The portion of the cartridge next the ball is filled with an explosive substance which resembles that used in percussion caps, and this is caused to explode by the contact of a small piece of steel, which passes from the outside of the barrel through the cartridge, and this contrivance has gained for the gun the name of the "nail-firer." An experienced soldier cannot discharge a percussion gun more than three or four times in a minute, and in the confusion of battle, one is all that can be counted on in that time, while this new gun can easily be discharged eight times in a minute. It is evident, that, from the long distance to which it throws the ball, this Prussian gun could be discharged many times before an enemy armed with common guns could get within shooting distance. It will be seen, therefore, that if this can really be brought into practical use, it will work a revolution in war. The Prussian government seems to be convinced of its usefulness, for fifty thousand of them are being manufactured for the army, and some were successfully used in quieting the late insurrection in Baden.—*London Athenæum for September*

HARPOON GUN.

Some experiments have been lately made near London for the purpose of exhibiting the advantages and power of a new harpoon gun, with which some of the South Sea whaling vessels have been provided. To show the simplicity of the invention, the patentee went into a whale-boat and with the very small charge of four drachms of powder projected the harpoon, with a line attached, a distance of 23

fathoms in a straight and unerring direction. A second time it was thrown to a distance of 30 fathoms, where it struck a bag of cork. This gun has been used on board of the Favorite, a whaling ship, with very great success, and during one voyage, though she had but one gun and three harpoons, 14 sperm and a large number of right whales were shot with it, some of them being killed on the spot.

A NEW RIFLE.

This rifle, known as Jennings's Patent Rifle, is designed to be an almost endless repeater, and to avoid the great difficulty of capping or priming each load, and also to be uncommonly free from dirt. In appearance the rifle is of the ordinary size, without encumbrance of any kind. Its weight is no greater than the ordinary weight of a common gun, and it only differs from the latter externally, in having an iron breech with a wooden stock, which breech is handsomely finished and engraved. By a simple contrivance within this stock, the breech-pin of the barrel is opened as the gun is cocked. A cartridge (of which we shall speak) is placed in this opening, and on pulling the trigger, the pin closes the barrel tight, a strong block of steel falls behind it, and the gun primes itself and is discharged all at one motion. There is nothing complicated in the machinery, but, on the contrary, it is so simple that it can hardly by any accident get out of order, and in case of such accident, any worker in iron can repair the break. By this contrivance a rifle is made capable of being loaded at the breech as often as it is fired off, and as rapidly as a man's hand can move to throw in a cartridge. This is at the rate of twelve shots per minute, for a person who has practised with the gun; a velocity sufficient to make one man fully equal to a dozen armed with ordinary rifles. Another variety of the same gun is now nearly completed by the patentees, which differs not at all from this in external appearance, except that in place of the ramrod is a tube of the same size, capable of containing twenty-four cartridges, which, by a very simple contrivance, are so arranged that they are placed in the barrel, one by one, and fired successively without any interruption. The moment that the twenty-fourth ball is fired, this gun may be used as the first one, loaded at the breech, and be fired at the rate of twelve in a minute. But the chief strength of this formidable weapon rests on the cartridge which is used, and for which the gun is expressly manufactured. This cartridge, which is also patented, is simply a loaded ball. A hollow cone of lead, or rather a bullet elongated on one side in a hollow cylinder to about one inch in length, is filled with powder, and the end covered with a thin piece of cork, through the centre of which is a small hole, to admit fire from the priming. As each ball goes out, the cork cap remains in the barrel, and is carried out in front of the next ball, sweeping thoroughly all the dirt with it. The gun may thus be discharged from forty to fifty times in good weather, without needing a swab. The barrel may be detached at a single blow of a hammer or stone, and a swab run through it in a moment, *at any time;* the operation of cleansing occupying no longer than the

ordinary loading of a common gun. The priming of the rifle is in small pills, of which one hundred are placed in a box, from which the gun supplies itself without fail.—*Journal of Commerce.*

A NEW GUN.

MONSIEUR VANDENBERG, of Brussels, has invented a new gun, said to be far better than the famous Prussian *fire-needle* gun. From six to eight discharges can be made in a minute; the carrying distance is from 2,000 to 2,300 feet; the ball weighs about one ounce and a quarter, and the powder is one twelfth the weight of the ball. An ordinary gun requires three times more powder, although the ball does not weigh half an ounce. The new gun is loaded from the breech. The shape of the ball is round, not conical, as in the Prussian gun.

MACHINE FOR MAKING PERCUSSION CAPS.

THERE is now in operation, at the Arsenal in Washington, a machine for making percussion caps, which is spoken of as being superior to any other in use. A sheet of copper, 14 by 28 inches, is placed upon a plane surface, called a "table," and the motive power being applied, the sheet, by an alternate motion, passes under the cutting die, which forms perfect caps, and then throws them into holes around the edge of the "charging-plate." This plate, which has a rotary motion, is about eighteen inches in diameter. It carries the caps round upon it, passing them successively under a cup containing the percussion powder, from which a sufficient charge drops, with entire regularity, into each cap. A little farther along is a very fine punch which presses the powder home, and thus completes the process of making, and after being carried on a short distance, they are thrown out by a small machine into a funnel, through which they fall into a drawer beneath. Thus, by the same unchanging motion, the cutting die is furnished with the material, the caps are cut out, loaded, pressed, and thrown into a drawer, at the rate of 4,000 an hour, with the labor of only one person.

NOVEL MODE OF WARFARE.

AT the siege of Venice by the Austrians, during the past summer, an attempt was made to bombard the city by means of balloons, the numerous marshes and lagunes in the vicinity preventing the near approach of artillery. Five balloons, each twenty-five feet in diameter, were launched with a favorable wind, and directed as nearly over the city as possible. To the cars were attached five bombs, communicating, by means of a wire, with a large galvanic battery, placed on a favorable station, on the ground. On the balloons attaining a nearly vertical position over the point of attack, the fuses were ignited by cutting the wire, the bombs falling perpendicularly, and exploding on reaching the ground. The experiment, although ingeniously carried out, proved a failure, the bombs producing little effect, other than frightening the inhabitants of the city.

IMPROVEMENT IN GUN-CASTING.

A NEW method has been resorted to at the cannon-foundry near Pittsburg, for the production of guns. Instead of bringing them from the mould solid, and afterwards boring them, they are cast with the proper bore; the core being carefully prepared so as to inclose a circle of cold water, which it receives and discharges in a continuous current, during the process of cooling, the object, probably, being to chill the inner surface more rapidly than the outer, and thereby give to it a greater density and strength. The plan is the suggestion of Lieutenant Rodman, and two guns—one cast on the old and the other on the new plan—having been subjected to the usual tests, the first exploded on the 84th, and the latter on the 255th round. This shows a great superiority over the common mode of making cannon, and if future experiments substantiate the successful one, Lieutenant Rodman's invention will come into general use.

NEW MODE OF MANUFACTURING SHOT.

MR. SMITH, of the firm of T. Otis Leroy & Co., New York, has invented a new mode of manufacturing shot, which entirely removes the necessity of having the expensive towers now in use. In the ordinary process, the lead, after being dropped, in a fluid state, from a perforated vessel, falls from the top of the tower to its base, and the tower must necessarily be of considerable height in order to give the shot time to cool before reaching the reservoir of water at the bottom. But by the new process the liquid lead descends through an upright circular pipe, arranged over a reservoir of water, and near the bottom is a fan wheel, which produces a constant current of air that meets the lead in its descent, and while it tends to decrease the rapidity of its fall in some degree, it also imparts to it a sufficient degree of cold to solidify the shot effectually, before they reach the reservoir, whence they are transported to the drying table, by means of an endless band of buckets, or elevators.—*New York Path Finder.*

CHAIN PIPES FOR TELEGRAPHS UNDER WATER.

MR. WHISHAW presented some links of a full-sized pipe for inclosing the wires of electric telegraphs under water. The pipe was formed of links connected together by sockets, each link varying, according to circumstances, from 18 inches to 24 inches in length, and from 1 inch to 2½ inches internal diameter, according to the number of wires to be inclosed. These pipes, being of wrought-iron, are exceedingly strong, and are required merely as a protection to the wires, which are previously insulated by means of gutta percha. Pipes of somewhat similar construction are laid under the Rhine and other rivers in Prussia,—where the underground system of telegraphs is adopted by the Prussian government (already to the extent of 1,200 miles),—although many of the railway companies suspend the wires between posts, as practised in England, America, France, &c. —*Proceedings of the British Association.*

STONE-CUTTING MACHINE.

A HIGHLY useful and important machine for the cutting and dressing of stone has been invented and patented by Mr. Charles Wilson, a mechanic of Springfield, Mass. It is remarkable for the simplicity, as well as the rapidity, of its operation, while the surface it produces on the stone is far more true and smooth than that where the chisel is used,—so much so, that it would not pay to employ machinery in making the final finish, it being so easily rubbed down by hand. The wear of the cutters is much less in cost than that of chisels, and the stone is left perfectly sound, not being the least "stunned," as the phrase goes. The following is a brief description of the machine:—

"From eight to twelve circular plates of steel, seven inches in diameter, and as thick as a common circular saw of that size, are placed alternately with iron washers one fourth of an inch thick and half an inch less in diameter than the plates. These washers and plates, being firmly fastened together, form a compact cylinder or broad wheel, termed the 'cutter,' presenting to any surface over which it is rolled numerous steel edges, one fourth of an inch apart and one fourth of an inch deep. Two of these cylinders, being each supplied with an axis, are set to revolve in an 'iron head,' which is made to pass briskly back and forth across the stone as the latter is slowly moved along by a process like that used in saw-mills. The cylinders, taking only such motion as is given them by being rolled over the stone,—the same motion as that of a carriage-wheel on a road,—crumble the surface of the stone on their way to a powder, with a power which no granite can withstand, taking away a very little each time, but coming very often, and effectually doing the work. The cylinders are set in the head at an inclination of about 25 degrees from a horizontal line, about the same angle as that of the chisel when struck by the mallet, and so as to cut away the stone by a bevelled edge."

In a recent exhibition of the working of this machine, a block of red sandstone, from the valley of the Connecticut, was placed on the "bed," and submitted to the action of the chisels. In eight minutes its surface, 4 feet long by 1½ broad, equal to 6 superficial feet, was dressed smoother and more even than the common chisel could have done the work, and this with a moderate speed of the machinery. An engine of two or three horse power is sufficient to drive one machine.

NEW BRICK-MAKING MACHINE.

THIS machine, the invention of an Englishman, consists of an iron cylinder, which receives the clay at the top, and passes it through a number of knives, which are fixed to a centre-shaft, which act as tempers of the clay, and press it into a curiously-shaped screw. This in turn gives pressure to a chain of moulds, which passes up an inclined plane and delivers the finished bricks on a table. The entire motive-power is communicated by the upright shaft in the cylinder. By the application of an engine of three horse-power, the machine will make

20,000 bricks in 10 hours; but it may also be worked by any other motive-power, and it can be moved from place to place. It is suited for making common and fire brick and tiles.

MACHINE FOR TAKING THE YEAS AND NAYS.

A COMMITTEE of Congress last year had, for some time, models of two or three machines for taking the yeas and nays, under examination, and they finally reported in favor of one which is the invention of Mr. F. H. Smith, of Baltimore. It consists of a metallic case, two feet long and one broad, which is designed to be placed on the clerk's table. This case is composed of an upper and a lower steel plate, through which small pistons of steel, equal in number to twice the whole number of members in the House of Representatives, play perpendicularly; they are divided into equal sets, one being intended for the yeas, and the other for the nays. Between the two plates, and above the pistons, when not in operation, a roll of the House, specially adapted for the machine, is easily inserted, with the words *yea* and *nay* printed on the right and left of each name. This roll, when inserted between the plates, is readily adjusted by a gage, so that when one of the pistons is put in operation it ascends through the paper and cuts out the "yea" or "nay," as the case may be. The pistons are connected with the members' desks by means of wires passing under a false floor, where they are connected with two ivory keys, on which are engraved the votes corresponding to the pistons with which the wires are joined. The keys work by depression, like those of a piano. By the insertion of an additional plate in the case, the machine can be so controlled that no member can move his keys before or after the time allowed for voting. The roll must, for the purposes of the machine, be printed in the order of the seats, and not alphabetically, as usual. The objection to this and all machines of the kind, however, is, that there is no way of detecting any derangement in the machinery, and a member may suppose that he is voting, when in reality the pistons do not work.

SEWING-MACHINE.

THERE is now in New York city a new sewing-machine in daily operation, which, as far as it has been tried, has entirely answered the purpose intended. It has not, however, it is believed, been used except upon coarse material, and where the seam to be sewed is nearly straight. It is thus described in the *New York Tribune:*—

"On turning a crank with one hand, the machine sews seams of any length and any desired curve. The stitches are perfectly even and tight, and may be taken of any length. The work to be sewed is fastened in a sliding frame and gaged so that the needle shall strike the point of commencing the seam. The eye of the needle is near the point, and as it pierces the material the thread is carried through and caught by a hook, which holds it till the second stitch is made. It then drops the first, taking up the second and bringing it through it,

so that each stitch is looped upon the one behind it, the whole forming an interlinked chain. At the factory there are several machines, most of them employed in making salt-bags. About 15,000 are manufactured daily for the salt-works in this State. One machine will make from 800 to 1,000 bags per day."

NEW MACHINE FOR SPINNING WOOL.

Two citizens of Gardner, Me., claim that they have made an invention which is destined to effect a revolution in wool-spinning. It is well known, by those who are acquainted with this kind of manufacture, that wool cannot, like cotton, be drawn out and then twisted, but that it must be done by the same operation. The present method of performing the work is by means of "jacks," which take the wool or roping that has previously been prepared by the cards, and spin it into thread for warp or filling. The "jacks" occupy a large space, and require a great amount of labor and care to work them. But this new machine wholly dispenses with the "jacks," and the thread is both drawn out and twisted by the operation of this "revolving draft and wool-spinner." One of these machines occupies a space of only 4 feet 6 inches by 3 feet, and contains 20 spindles. It is claimed, that it will do the work of 50 spindles on a "jack" which occupies a space of 10 feet by 7. In other words, 50 spindles of the "jack" occupy 78 square feet, while the spinner occupies 13½. There is, besides this saving of space, a great saving of labor, as more work is performed with less manual assistance, and also a saving of power.

IMPROVED MACHINERY FOR SPINNING YARN.

MR. GEORGE H. DODGE, of Attleborough, Mass., has invented a valuable improvement in machinery for spinning winding-yarn, being a combination of the self-acting mule and throstle, and having many advantages over the common method of spinning, and equally applicable for filling and warp. In the room usually occupied for 1,000 mule-spindles 1,500 may be placed, which will do the work of 3,000 spindles. It occupies the usual space required for warp-spinning, but will, it is said, spin 50 per cent. more yarn to the spindle than the best ring-bobbin spindle in use, and with a saving of two-fifths of the power. It is estimated to spin 100 per cent. more yarn than the flyer spindle, and with one half the power compared to the quantity. The spindle is more durable than the common one in use, being tapered to the top, and there being no bobbins or check-pins used, it maintains its balance at any speed required. It is not liable to get out of order, and is much more convenient to piece up the ends when broken than the bobbin-frame. Messrs. Dodge & Sons have their entire mill upon this method of spinning, and say, that, from twenty-nine years' practical experience with other spinning, they believe it to be the best in use, and know that it is worthy the attention of manufacturers.

They are daily producing more yarn from 2,320 spindles than they

were able to do from about 4,600 spindles of the old plan commonly used, and have averaged the product of the above 2,320 spindles for nineteen successive weeks, without making any allowance for stoppages, or hindrance from other causes, and have spun 61,287½lbs. yarn, No. 30,—seven skeins to the spindle,—per day.—*Hunt's Merchant's Magazine.*

THE INVENTOR OF THE POWER LOOM.

Mr. Andrew Kinloch, the first man who ever weaved at a power-loom, died lately in Manchester, at the age of 90 years. In 1793, he set up the first power-loom in Glasgow, the propelling power being his own hand, and, after an outlay of $500, produced 90 yards of cloth. Shortly afterwards he removed to Milton Printfield, where forty looms were erected under his direction. In 1800, he went to England, setting up looms in various places in Lancashire, and more than once was in great danger of his life from the hand-loom weavers, who were jealous of his new invention. The power-loom remains as it was when he first invented it, with the exception of a few slight improvements.

IMPROVEMENTS IN THE MANUFACTURE OF CARPETS.

Several new improvements in the manufacture of carpets have been introduced into the English factories. One by Mr. Whytock, of Edinburgh, consists in employing printed warp in such a manner that all the wool is brought to the surface; and the substance of such carpeting, in place of consisting largely of wool, as heretofore, depends on a less costly, but stronger material. By this invention the simplest loom only is required; and the designer is in no way restricted as to variety of color. Any design of the artist may be executed, however many colors may be required,—increased numbers of colors not enhancing the cost. The peculiarity of this process consists in printing the separate yarns of which a warp is to be composed; and this is done in such a manner that each yarn having had its colors applied thereto, and the proper number brought together, side by side, to constitute a warp, the desired pattern is produced. Each yarn is wound on a cylinder of large diameter, having a graduated scale thereon, so that children (who apply the colors), having pattern-papers before them, have only to notice what colors are on the successive divisions of the pattern-papers, and to apply the colors, in succession, by passing color-rollers across the surface of yarn wound on the cylinder,—thus making simple marks of color on the yarn, at intervals, which being according to the designs on the papers, when the several yarns constituting a warp come together, the pattern is produced; and the warp being woven into a fabric, with raised pile by the use of wires, the most beautiful and varied results are obtained.

Another improvement lately introduced consists in printing Brussels carpets by a process similar to block-printing, using rollers, how-

ever, in place of blocks. Several specimens have been exhibited, which give considerable promise. The difficulty of printing Brussels carpets consists in getting the color to penetrate into the pile without spreading. This is only to be accomplished by repeated impressions;—hence the difficulty of using blocks or rollers, so that they shall keep register with different colors, and at the same time repeat accurately several times on the same surfaces. This difficulty, it is believed, has been overcome by the above invention.—*Abridged from the Proceedings of the Royal Institution.*

THE CARPET MANUFACTURE IN AMERICA.

THE most extensive manufactories in the United States are at Thomsonville, Conn. They use 10,000,000lbs. of wool, and 10,000lbs. of flax-yarn per annum. They manufacture three-ply, Brussels, and Axminster carpetings of the richest patterns, the weaving at present being mostly done on hand-looms; they are, however, about introducing power-looms into the factory, for weaving rugs and Axminster carpets. The wool for Axminster carpeting is first woven into a web, and afterwards cut in strips, forming what is called chenille card; this is done upon a machine invented by Messrs. Davidson and Parks, of Springfield, Vt., which is the first and only one of the kind in the United States. The machine has over 200 cutters, or knives, which are attached to a cylinder, making some 300 revolutions, and cutting two full yards of the web per minute into strips, which being passed over a grooved cylinder, heated by having hot irons inserted within it, is prepared for weaving. Besides this large carpet-establishment, there is in this village a factory, 100 by 43 feet in dimensions, and five stories high, for the manufacture of knit shirts, drawers, and fancy ginghams. This establishment has about 30 sets of wool-cards, and 25 or 30 gingham looms.—*Scientific American.*

LOOM FOR WEAVING CARPETS.

MR. JAMES M'KENZIE, of Schenectady, N. Y., has made some improvements on the carpet-loom, which are claimed to be important. They consist, 1st, in a new mode of arranging and operating the shuttle-boxes; 2d, in a new match-motion, or way, graduating the let-off speed of the warp-beam, and the take-up speed of the cloth-beam; 3d, in a new stop-motion. The shuttle-boxes are of a different form and motion from both the sliding and the rotary boxes now in use, and are termed quadrant boxes. They are quarto-rotative, and are shifted by a back spring at any point desired, being set for this purpose. The match motion is difficult of explanation; the principle of it consists in having a guide apron or rest, pressing by a spring against the warp and against the cloth-beams, and according as there is more or less yarn on the one beam and cloth on the other, to require a corresponding increase of surface motion on the warp-beam, and a decrease on the web-beam, a blade from the lathe at every stroke is so guided by the guards or rests on the warp and web

beams, as to move a ratchet lever the exact distance required in gathering round the teeth of the beams to graduate the let-off and take-up in unison. The stop-motion is a double-finger one, which, when the thread breaks, at once detaches a crank-lever, which throws the driving-belt on to the loose pulley and effectually prevents all breakage.—*Scientific American.*

NEW LOOM PICKER.

MR. GEO. W. PERRY, of Fall River, Mass., has invented a new mode of combining and operating a picker for power-looms, which has been in operation for some time, and has proved a valuable improvement in the weaving art. The picker moves continually in a straight line in the raceway of the lathe, obviating the use of the common horizontal spindle, on which the picker runs, and it is also much more easily taken out and put in, besides being less complicated and expensive than the picker in general use. This picker is made of a rectangular form, to slide on the raceway freely in the shuttle-box. It has an opening through the middle, through which passes the picker-staff, driving the picker by moving reciprocally in a longitudinal slot cut in the raceway of the shuttle-box. The picker-staff is not secured to the picker, but merely has its upper end passing freely through it, and a flange is secured on the top of the shuttle-box, projecting inwards, so as to prevent the picker from being raised up. The picker-staff has a reciprocating motion from a pivot-axis below, at its base, by which it is secured to a vertical standard attached to the shuttle-box. The top of the picker-staff, therefore, describes considerable arcs, but as it passes freely through the picker it moves in a straight line with but little friction, especially since the ends of the openings of the picker are made in a curved form, which allows the picker-staff to roll in it, but yet to move the picker according to the parallel motion of Watt. The picker-staff may even be dispensed with, owing to the form of the picker, and a simple tenon secured to the same by passing down and being connected with a central wag-staff by a cord, may answer every purpose, in a more simple manner, but with somewhat more friction.—*Scientific American.*

IMPROVED ENVELOPE MACHINERY.

ONE million of envelopes are daily manufactured in the British Islands. Each of these requires to be cut and folded with precision. The former operation is performed partly by a patent cutting-machine, and partly by means of a sort of large hollow chisel, the cutting part of which is exactly the shape of the required envelope. The folding was, till within a recent period, entirely done by manual labor, but latterly by a folding machine, the invention of M. de la Rue. By means of the admirable precision and rapidity of this engine, forty-two envelopes can be folded in a minute. The machine consists of,—1. A *table*, or metallic surface, of the exact size of the envelope which is laid on it, and which moves on a vertical plane. 2. A corresponding surface, called the box, which, descending on this table,

creases the envelope, and then opens so as to permit the partial folding of it. 3. Four *folders*, two of which press down the corresponding flaps of the envelope before the box is entirely raised; the two others follow with their pressure, after the remaining portion of the box is lifted up. 4. Two finger-shaped projections, made of caoutchouc, which, owing to their property of adhering to a paper surface, never fail to carry off each envelope as fast as it is folded. Though there are twenty-two movements for folding each envelope, and each successively performed with great rapidity (the several motions succeeding each other), there is no blow or jar of any kind in the working of the machine. This is the effect of a regulation of velocity produced by *cams*.

In connection with this subject, we would also call attention to an ingenious contrivance for identifying a letter with its envelope, recently introduced into the Post-Office Department of Great Britain. It consists of a set of perforations which, when the Post-Office stamp is used, cause some portion of the ink to press through the envelope to the inclosed letter, so that, when the two are put together, they complete the lettering of the stamp.—*London Athenæum.*

MACHINE FOR MAKING ENVELOPES.

THERE is in operation, in Philadelphia, an ingenious machine for the manufacture of envelopes, an article which, within a few years, since the alterations in our postage-laws, has come into great demand. The process of the manufacture is thus described. A pile of paper is first laid under the cutting-press, and the flat forms of the envelopes are cut out at once. These are then taken to the folding-machine, which is one of the most singularly constructed and beautiful pieces of mechanism we have ever seen. It requires but one person to feed it, and performs all the rest of the operations itself; for the paper, cut in proper form, being placed in a fixed position, is seized by nippers and drawn forward to a bed, where it is held firmly by an over-hanging plate of metal, which covers just so much as marks the size intended to be made, leaving the parts to be folded over loose. The sides are then, by means of plates advancing towards each other, folded over, and, as they retire, a roller covered with gum passes under the surface of a double curved piece of brass, which instantly falls upon the paper, and, as it rises, another plate turns over the inside fold, while at the same time a roller presses on it and causes adhesion. This being done, the bed on which the envelope rests falls to an inclined position; and, being caught between rollers, the finished article is passed through a trough into a receiving basket. The only remaining labor is to gather the envelopes up and sort them into packages of twenty-five each. The whole is done with great rapidity, and so various and contrary are the motions of the machine, that it appears almost to be in some degree sentient.

FLOATING FILTERING-PUMP.

A Patent for a new floating filtering-pump has recently been granted, in England, to Mr. S. Cheavers, of Lincolnshire. Its advantages are to procure a pure and wholesome, as well as an abundant supply of water; results which, it is believed, have not hitherto been combined in a pump. The inventor states that the floating filtering-pump has been tested in a tidal river, and is now used in an extensive brewery in Spalding, where it furnishes an abundant and constant supply of wholesome water, entirely free from sand-filth, which the old leaden pipes, by being placed nearly to the bottom of the water, were in the constant habit of contracting, thereby preventing the engine from obtaining a sufficient quantity of water for the supply of the brewery; and, as a still greater proof of its utility, it may be added, that it has been frequently surrounded by the weeds and rubbish carried down the river, and yet has never, in one single instance, failed to produce a copious supply. Water is purer and sweeter at the surface than it is at the bottom, and the floating filter totally ejects filth of every description, such as worms, &c., and all impurities of the smallest kind. The common pump, in consequence of the pipe descending within six or eight inches of the bottom, draws up with the pure water every pernicious sediment within its reach. On the other hand, the floating filter, by taking a supply of water within four or six inches of the surface, and rising and falling with the water, at once secures it from all sediment; and should there be any light filth floating in the same, the filter totally ejects it, and will supply hundreds of tons of pure and wholesome water daily, if required. The patent filter may be fixed to tanks and butts, so as to remove all apprehension of unwholesomeness in the water, by any impurity drawn up with it. The filter can be attached, without difficulty, to pumps of the old construction.—*New York Farmer and Mechanic.*

HOE'S PRINTING-PRESS.

La Patrie, of Paris, while paying a compliment to one of our American mechanics, Mr. Hoe, of New York, gives a description of the working of his new printing-press, which we insert, instead of one which we had ourselves prepared.

"This press, the invention and manufacture of Mr. Hoe, prints off 133 copies in a minute. It often exceeds this number, because its velocity and swiftness depend upon the speed with which the workmen are able to supply the sheets of paper. When our journal, *La Patrie*, first began to use this press, the workmen, or feeders, were only able to feed it with 4,000 sheets per hour. But since they have acquired, by constant practice, greater skill in their work, they sometimes supply the enormous quantity of 8,760 sheets per hour, which the machine of Mr. Hoe prints off.

"It is now above four months since this press has been in constant use and operation in our office. The proprietors are so well satisfied with its performance, that they have given an order to Mr. Hoe for

another machine of the same description and on the same plan. This machine will have six printing-cylinders, and will strike off 12,000 copies in an hour!

"Notwithstanding the above astonishing results produced by Mr. Hoe's Machine, yet such is its simplicity, that a few lines will be enough to explain the principle of this wonderful invention. A horizontal cylinder, 1.35 yards in diameter, moves upon an axle which rests in its sockets. One fourth, or thereabouts, of the circumference of this cylinder constitutes the bed of the press, in which the chase containing the letters, or type, is placed; the remaining portion of the cylinder is applied for the distribution of the ink, which is put into a receptacle underneath the great cylinder. The feeding-roller takes it off, and, by means of another roller, which has a vibrating, oscillating motion, it spreads it over the form upon the great cylinder. The feeding-roller revolves with a slow and regularly sustained motion, taking the ink gradually out of the receptacle in which it is deposited. When this large cylinder is in motion, the forms are made successively to come in contact with each one of the four horizontal cylinders, which are arranged at suitable distances round the great cylinder, to print off the four sheets supplied by the feeding-rollers. The sheets are laid hold of, direct from the edge of the supplying table, by iron hooks, fixed upon each feeding or depositing cylinder. The receivers of the sheets are supplied by means of wooden frames, which take them from the conducting straps or bands, and place them in a regular pile upon the four receiving tables. In front of each one of the cylinders there are two inking-rollers, which pass over the cylindrical surface devoted to the distribution of the ink, take up the ink upon their own surface, and lay it on the types by the revolution of the main cylinder.

"Four forms are printed off at once by Mr. Hoe's press, each form being in a separate and distinct chase. They are four superficial segments of a cylinder, detached from each other, and which are at pleasure attached to or detached from the great cylinder. The usual types are employed on this press; they are fixed upon the great cylinder, and revolve continually, without any danger of becoming loose, being retained in their place by a plan peculiar to this press. The great central cylinder, on which the forms are fixed, revolves from left to right; whereas the four others, or pressing-cylinders, revolve from right to left. The paper is placed by the workmen in such a manner that it slips between the two cylinders on one side, and comes out, perfectly printed, on the other side, when, by means of suitable straps and bands, the sheets are arranged in a pile, under frames, which rise and fall alternately."

La Patrie also makes a curious calculation of work done by this press:—

"The journal *La Patrie*, contains about 4,320 lines; 8,000 copies make 34,560,000 lines. A scribe could write about three lines in a minute; therefore, it would require 11,520,000 minutes, or 192,000 hours, for a single scribe to supply 8,000 copies of *La Patrie;* or, in other words, it would require 192,000 men to supply, by copying, the

same amount which Mr. Hoe's press supplies in one hour! Thus his press accomplishes as much as it would take the half, at least, of the whole French army to supply!"

CHEMITYPE PRINTING.

ANOTHER species of engraving has been brought before the public, to which the name of Chemitype Printing has been given. By this method an etching or engraving, made in metal in the usual way, may be converted into a high-relief stamp, to be used in printing on an ordinary press, as is the case with common wood-engravings. The following statement may in general illustrate the character of the invention. On a highly polished plate of pure zinc an etching or engraving is made in the usual manner, which, under common circumstances, would be fitted for impressions on an engraver's press, having the same harmony and proportion of all the respective etched or engraved lines. The tracery, thus deepened, is now to be fused or melted down with a negative metal, and the original metal plate (zinc) corroded, or etched, by means of a certain acid, thus making the characters of the former drawing appear in the shape of a high-relief stamp. This effect is only produced in consequence of the metal composition in the lines of the tracery not being acted upon by the acid, on account of the galvanic agency subsisting between the two metals, and the acid corroding only the zinc.

After these details, there cannot be the least doubt of the specific difference between the chemitype printing and glyphography, relief etching in copper, and other similar artistical processes and practices lately invented. Its principle rests upon the positive and negative nature of the metals. As every drawing on the metal plate is completely exact on the relief stamp, the practice is absolutely independent; the exact and accurate representation of the original sketch is always to be expected. Wood-engraving cannot, in most cases, be superseded by this novel method; but in many other instances the new practice is preferable, chiefly when colored printing is required, in the representation of maps, plans, architectural drawings, &c. &c. At the same time, the correction or improvement of any drawing can be much better executed than in wood-engravings.—*Scientific American.*

IMPROVED MACHINE FOR PRINTING WALL-PAPER.

THE inventors of this new machine for printing wall-paper, oil-cloth, &c., are Messrs. Gould & Shaw, of Newark, N. J. The machine is so made as to give to two blocks, placed in two plattens, an intermittent, reciprocating motion, so that two impressions are made during the forward and backward stroke of the piston that moves the blocks. It also supplies the blocks with color from two boxes, as well as feeds in the paper or material to be printed, and takes it away. The principal machinery consists of two long tables, transverse to each other, one being the feeding-table, and the other the printing-frame. At the end

of the latter is a large drum, with a projecting eccentric flange, or rail, fastened to its periphery. The head of the piston, which moves the blocks, grasps this rail, but is guided in a straight line by a guide-rest, so that when the drum revolves, the piston-rod will be guided backwards and forwards by the angular part of the rail, but it will be stationary while that part of the rail around the end of the drum is passing through the jaws of the piston-head. This gives the piston-rod and blocks attached an intermittent reciprocating motion. The printing-blocks are secured to the plattens on the inside, but the latter are placed a little distance below the paper, and are secured to coiled springs at the corners, which allow the blocks to be pressed down, but raise them up when the pressure is removed. The plattens, therefore, have square stationary frames around them, all connected together, and slide along on the table guided by up-raised rails on each side, which fit into grooves in the platten-frames. From the framing above, three spring pistons are suspended, which are forced down on the plattens to make the impressions during the intermissions of the blocks. There are, therefore, four cams on the shaft above, the middle ones being double and the other two single. The side cams alternately press down one block on to color cushions to supply it with color, and the middle ones press down the block which makes the impression, so that the motion of the cams coincides with that of the piston-rods. Thus much for the operating of the blocks. The paper is fed under the blocks on the cross-table, between guide-plates. The paper passes through to a small catching-bar, which has a vibratory motion, and catches and lets go, to draw the printed paper from under the blocks, and to feed in unprinted paper for the next impression. The catching-bar is operated by crooked levers, secured to one of the block frames, and oscillating on a pivot fixed on a block of the feed-table. All the motions are thus in harmony with that of the drum which works the whole. For certain kinds of work the advantages of this machine are apparent.—*Scientific American.*

MANUFACTURE AND USE OF COPPER TYPE.

A MACHINE has been invented and patented in England, for the manufacture of printing-types, without fusing the metal and pouring it into moulds. The inventor, Mr. Petit, effects his process by the use of steel dies and matrices, which, by means of powerful pressure, impress the letters and characters on copper, fashioned into quadrangular strips of an indefinite length, wound round a cylinder; the type being struck, or punched, the same moment that its size is mathematically determined. The machine exhibited to the Royal Society, in June last, produced 32 types per minute; but by the application of a small steam-engine to the type-making machinery, it is estimated that 60 per minute can be struck, or 36,000 per diem. The types thus produced possess the utmost sharpness of outline and hardness, in consequence of the superiority of the metal employed and the pressure to which they have been subjected. The hardness

of ordinary copper over type-metal is in the proportion of 100 to 1, and the density of the copper used in the manufacture of type is considerably increased by the compression which it undergoes in the machinery. A London firm, employed to print stamps for government, is in the habit of using raised copper surfaces for the purpose;—no less than 125,000,000 impressions having been taken from a single plate. It is impossible so say, at present, to what extent the new type will surpass that in use, as regards durability. They can, however, be produced much cheaper than even under the present system. In proportion as founts of type decrease in size, they rise in price, but a decrease in weight, under the new system, will be accompanied by a diminution in cost; and when, ultimately, the sharpness and clearness of the type has been, by long use, deteriorated, the metal will retain an intrinsic value far above what the present composition of metals now used for printing-types does in similar cases. The machine has received the name of the Apyrotype, and is undoubtedly one of the most important and most desirable inventions of the year.

IMPROVEMENT IN GRAIN-SEPARATORS.

This machine is the invention of Benjamin D. Sanders, of Virginia, and it is designed to separate the impurities in threshed grain, upon a different principle from that of the common grain-separators. Instead of forcing the chaff from the good grain by means of a blower, a vacuum is created, the power of which can be regulated at will, by which every thing specifically lighter than the good grain is raised up into a receiver, while the latter is not raised off from the screens, but passes over them, and falls into a granary below. As soon as the vacuum is created, a current of air rushes from below, and its force must be regulated according to the height to which the impurities are to be raised. The good grain is thus deposited in a granary by itself, while that which is light is forced up into a receiver, and the chaff is entirely driven out from the machine.—*Scientific American.*

COTTON-SEED EXTRACTOR.

This new invention of Mr. Stephen R. Parkhurst is said to be the most perfect machine of the kind, and will prove of the greatest advantage to all branches of the cotton manufacture. The machine is of the simplest construction, and it seems a wonder that the idea had not been long since suggested. It is composed mainly of two cylinders, closely set together, a feeder, and the ordinary fan. The cotton containing the seed is thrown on the feeder, from which it is taken by the cylinders, which extract the seeds whole, the cotton being passed by the fan into a receiver. The quantity of cotton cleaned by this machine will far exceed that of the ordinary saw-gin now in use, and a third less power is required to keep it in operation. By this method the texture and length of the fibre are completely preserved, the value of the cotton will be greatly enhanced, and the intrinsic worth is increas-

ed from a cent to a cent and a half per pound. It is calculated, that *a thousand pounds* of cotton can be extracted in the same space of time that is required to extract *twenty-four pounds* by the common saw-gin. The machine may be worked for ten years without requiring repair. —*New York Farmer and Mechanic.*

STEAM-PLOUGH.

A SERIES of experiments on the application of steam-power to the plough has lately been made near Reading, England. Some practical and scientific gentlemen were present, and expressed their gratification at the success of this important improvement in the working of the plough. It can be used on any kind of land.

IMPROVEMENT IN MAKING FLOUR.

D. P. BONALL, of Tecumseh, Michigan, has recently made an improvement in the process of manufacturing flour, which is claimed to be valuable. The *Indiana State Journal* publishes the following extracts from a letter written by Mr. Bonall in reply to inquiries made of him in reference to the improvement:—

"My 'improved process of milling' consists in separating the starch part of the wheat from the glutinous matter, and submitting the latter to a second grinding. The way it is effected is by placing an auxiliary run of stones so as to receive the entire body of the 'offal,' on its passage from the upper or first merchant-bolts. The stones are fitted to run from 300 to 400 revolutions per minute, and the feeding of the stuffs is made uniform and perfect by a very simple combination of machinery. After the 'offal' is thus ground, or severely scoured, it is then passed into the lower bolts, or dusters, when the flour is taken out and sent to the 'cooler,' or first bolts, to be uniformly mixed, in regular proportions, with the superfine flour, and the remainder separated for feeds.

"The advantage obtained by this mode of grinding is as follows. 1st. It enables the miller to grind high, or coarse, at the first grinding, and thus avoid injury to the 'starchy' portion of the wheat, and insures free, good bolting, which is not always the case when attempting to grind the starch and 'gluten' contained in the grain to the same consistency by one process, as the starch, which pulverizes easy, is apt to be too fine, and stick to the bolts, or else the 'farina' is too coarse and goes to middlings, or adheres to the bran, and is lost. 2d. It enables the miller to grind wet or damp wheat better than any other mode, as the first grinding, which is high and free, warms the wheat, where, by elevating, cooling, airing, and bathing, the moisture is principally evaporated, and the 'offal' is partially kiln-dried, when, by submitting it to the quick grinding or scouring process, the flour is almost entirely 'whipped out' and put into the superfine barrel. 3d. It catches all the broken particles of grain that escape the first grinding by stopping and starting, or from other causes, and equalizes the grinding, when any variations occur in the first mills or grind-

ing. 4th. It adds to the superfine flour that which was formerly 'fine,' and thus saves the loss on sales in market. 5th. It saves grinding middlings, as the whole middling process is done by one continuous operation, with a great saving of labor as well as time. 6th. It enables the miller to make his barrel of superfine flour from four bushels of wheat, that will weigh 60lbs. to the bushel, and the flour is much better, as it contains much more of the 'farina' of the wheat or glutinous matter, and will yield more good bread from a given quantity of flour. Flour ground on this process is now selling in Buffalo as a superior brand.

"The double grinding evaporates more of the moisture, and has a tendency to preserve the flour longer from souring."

The aggregate saving made by this improvement will, it is asserted, be from 15 to 25lbs. on each barrel of flour.

A miller at Tecumseh writes that he has introduced this process into his mills, and has made nearly 4,000 barrels since then. He gets in Buffalo 12½ cents more per barrel than any other Michigan flour is sold for, and considers that he saves 20lbs. of wheat in every barrel of flour, while the quality is much superior.

THE ALEUROMETER.

M. Bolaud, of Paris, has invented an ingenious instrument, called by him the Aleurometer,—the purpose of which is to indicate the panifiable properties of wheat-flour. The indication depends upon the expansion of the gluten contained in a given quantity of flour,—say 500 grains,—when freed, by elutriation, from its starch. A ball of gluten being placed in a cylinder to which a piston is fitted, the apparatus is exposed to a temperature of 150 degrees; as the gluten dilates, its degree of dilatation is marked by the piston-rod. If 25 degrees of dilatation are not obtained, the flour is rejected,—the best flour usually giving from 38 to 50 degrees. From experiments conducted by members of the French Academy, it appears that the dilatation shows correctly the degree of deterioration which the wheat-flour has undergone,—and consequently the Aleurometer offers itself as an instrument of practical importance. The same principle may be applied to various other purposes; indeed, a new alcohol-meter has been constructed, of a character similar to the Aleurometer.

PATENT HOT-AIR HEXAGONAL BISCUITS.

The *London Traveller* furnishes the following description of a new method of making and baking ship and other biscuits, lately introduced into the extensive establishment of Mr. Harrison, Liverpool. It is believed to surpass any other method now in use, as far as regards economy of time and material. The flour and water, in proper proportions, are placed in a cylinder, and the first operation of thoroughly mixing is performed by arms inside. On leaving the cylinder, the dough is kneaded by means of a large iron cylinder, under which it is passed several times. The required thickness is attained on passing

beneath a smaller cylinder. The dough, spread out like a large sheet, then passes along an endless cloth, the machinery moving, at each stroke, the precise width of a biscuit. As the dough passes along, by the rising and falling of a nicely adjusted piece of mechanism, the biscuits are cut into shape and receive the stamp of the patentee. The biscuits are not circular, but have six sides, and therefore there is not, in cutting out, any waste of dough, except a very small portion at each end. Passing along the endless cloth, the biscuits are conducted to the mouth of the oven, where they are received on a machine, which draws in the biscuits in a few seconds. Each oven is 4½ feet in width, and 26½ feet in length. There are four ovens, one above another, and all fed from the same furnace with hot air. The mixing of the flour and water occupies about 12 minutes, the kneading 5 or 6, and firing half an hour. As each oven contains 650 biscuits, and they may be filled within a few minutes of each other, there is no difficulty in producing, from flour and water, no fewer than 2,600 biscuits in an hour, or nearly a ton of ship-biscuits every two hours. The biscuits, too, are of excellent quality,—beautifully crisp and sweet.

PREVENTION OF SMOKY CHIMNEYS.

Sir Henry Hart, the Commissioner of Greenwich Hospital, has lately patented an invention for promoting the draught of chimneys, and thus preventing them from smoking, while at the same time it aids the ventilation of rooms. The apparatus consists of a fan-wheel in the centre of the chimney-top, the axis being horizontal, immediately on a level with the orifice. One half of the wheel thus projects above, and is open to the influence of the wind, while the lower half is shielded from it, and the wheel is therefore made to rotate with great rapidity, and acts like a screw to force up the smoke or vitiated air from below. A diaphragm is placed across one half of the chimney to prevent any air being forced downwards, so that the smoke is confined to one half of the chimney.—*Albany Cultivator.*

WIRE AS A SUBSTITUTE FOR LATH.

Fire-proof ceilings of wire-work have been successfully applied in place of lath, with plaster and stucco, as usual, at the Chester Lunatic Asylum. The wires are placed about a quarter of an inch apart, and the plaster forms an adhesive and serviceable mass, which is even on both sides. The wire is galvanized, or japanned, to prevent corrosion. Not only ceilings, one would think, but thin partitions and walls in general, might be wired instead of lathed, and the risk of fire would thus be greatly diminished by a process not at all costly.—*London Builder.*

NEW GASOMETER.

The Boston Gas-Light Company have just erected an immense new gasometer. It is 80 feet in diameter, 40 feet high, and the crown of the roof is 5 feet, making the entire height 45 feet; its working capacity is 200,000 cubic feet. It weighs 116,000lbs.

IMPROVED BANK-NOTE PAPER, FOR THE PREVENTION OF FRAUD.

A commission, appointed by the French Academy of Sciences, in connection with the French government, whose object it was to discover a paper to be used for bank-notes, deeds, &c., which should resist the arts of forgers and counterfeiters, have reported to the Academy that their efforts have at length been crowned with success. They take a glance at the repeated endeavors which have been made, to effect this desirable object, from which it appears that the experiments and investigations have been almost constantly going on since 1826, during which period numerous plans have been submitted, to all of which there has hitherto been some objection. The successful competitor, M. Grimpé, has from the beginning sought to attain the desired end by means of a delible device extending all over the surface of the paper, and composed of lines too delicate to be reproduced by hand, and which, being printed with delible ink, should be exposed to attack by all the agents which affect writing, and when once effaced, could not be restorable by the most skilful hand, or by any printing process. The principle, as improved and adopted, consists in covering the paper with a microscopic device, printed on both sides with delible ink by means of a cylinder. The nature of the device, the mode of engraving the cylinder, and the nature of the ink and paper, have, during the last eleven years, been the object of incessant discussion and study on the part of some members of the commission. It has finally been concluded to engrave the device upon the cylinder by means of a steel roller, having the device upon it in relief, which, by strong pressure, reproduces it in intaglio upon the copper cylinder. After experimenting with various devices, such as concentric circles, hexagons, &c., microscopic stars have finally been decided upon. This device presents insurmountable obstacles to its reproduction by hand. The stars are produced by a single steel punch, or die, having a single star engraved upon it; which punch, being highly tempered, is caused to stamp the stars all over a soft steel cylinder, which is then tempered, and can be used to reproduce the device, as often as required, upon other cylinders, especially copper ones. The cylinders to be printed from are now engraved in relief, instead of intaglio, as by the former method the ordinary writing-ink can be used, which is not the case when printing from intaglio. The commission also insist upon using paper made by hand, a sheet at a time, and sized by gelatine, which is always rather uneven on account of the water-lines and there being no division of the pulp. This sort of paper is much more durable than any made by machinery.

Thus the grand object has been accomplished. In a few words, M. Grimpé has succeeded in covering the two surfaces of the paper (without changing its nature) with a device which cannot be imitated by hand, or transferred on to stone, and which can be printed with ordinary ink. The commission conclude their report by stating, that they have obtained undeniable proof that any stamp or device hitherto known may be imitated, but for obvious reasons do not mention the methods.—*Comptes Rendus, July* 23.

AMERICAN MICROSCOPES.

Mr. Spencer, of Western New York, has hitherto been almost the only person in this country who has turned his attention to the manufacture of microscopes, and he has succeeded in producing some instruments of great power and excellence. Most of those, however, at present in use in this country are of foreign construction. About a year since, Mr. J. B. Allen, of Springfield, Mass., having had his attention called to the subject of microscopes, with true Yankee perseverance and ingenuity, set about the construction of one of these instruments. Although he had never seen but one microscope, and that only for a few minutes, and had never seen a piece of glass ground, he devised his own tools and processes, and in the course of a few months produced an instrument, which he exhibited to the American Association, at Cambridge, in September. The power of this instrument was about 1,300, and it received the most unqualified commendation of the distinguished men there assembled. Professor Agassiz, after a careful examination of it, made a report, in which he spoke in the highest terms of its excellence. This instrument was purchased by Amos Lawrence, Esq., of Boston, who liberally presented it to the academy at Groton, Mass.

By the advice of Professor Agassiz, Mr. Allen immediately commenced the construction of another microscope, with some improvements suggested by Professor A. This new instrument he completed in about three months. It was submitted to the inspection of Professor Wyman, of Harvard University, who carefully compared it with a similar microscope manufactured by the celebrated Oberhauser, and by him exhibited as one of his best instruments. The American specimen was found to be fully equal, if not superior, to the European, and there can be no doubt that it is the most excellent microscope ever produced in this country.

It may not be improper to mention, that Mr. Clark, of Boston, has succeeded in producing very fine telescopes, and that excellent chronometers are now manufactured in this country. Thus it appears that Americans have already made considerable progress in the manufacture of these delicate instruments.—*Editors.*

THE SONOMETER.

The sonometer is a simple and easily-managed instrument, and consists of a small bell fixed on a table. There is a pillar supporting a serrated bar, and kept in its place by a delicate spring, to which a

small hammer is attached. This spring, being placed in the teeth of the serrated bar, is relieved by the handle being touched by the finger, which regulates the extent of the sound from the ticking of a watch to the sharp, loud tone of a bell. This instrument tests with great accuracy the amount of hearing actually possessed by a person in every stage of deafness, so that its advantages must be evident to every one.

UNIVERSAL SUN-DIAL.

At the last meeting of the British Association, the President exhibited a universal sun-dial, constructed by a gentleman in Dublin. It consists of a cylinder, set to the day of the month, and then elevated to the latitude. A thin plate of metal in the direction of its axis is then turned by a milled head below it, till the shadow is a minimum, when a dial in the top shows the hours by one hand and the minutes by another. It appears by this that the time can be obtained to the precision of about three seconds.

MECHANICAL LEECH.

This apparatus, the invention of a Frenchman, consists essentially of two parts, an instrument for puncturing the skin, and another for promoting the flow of the blood by removing atmospheric pressure from the punctured part. The puncture is effected by a lancet, whose blade has the form of the cutting apparatus of the leech. This lancet is fixed in the mouth of a tube, and projects about the eighth of an inch beyond the edge; it may be elevated by a small lever, so that its point shall be within the tube. Attached to the opposite end of the tube by a piece of vulcanized India-rubber, which acts as a spring, is a piston, which is pressed down by a rod, and on removing the pressure is drawn back by the spring. The piston being pressed down, the open end of the tube, in which is the lancet, is placed over the part to be punctured; the pressure is now removed, when the piston is drawn back by the spring, and, exhausting the air within the tube, the skin is forced up into its mouth. On loosening the lever, the lancet is drawn down by another spring, so as to effect the puncture. The cutting instrument is then removed, and a glass tube with a piston is placed over the puncture, the air within being exhausted so that the tube adheres to the part, and the blood flows freely. A dozen of these tubes, each of which draws as much as a large leech, may be thus attached in two or three minutes. The idea of a mechanical leech is not new, but the use of the India-rubber springs forms the important feature of this new apparatus.—*London Medical Journal.*

PREVENTION OF MINE ACCIDENTS.

At the meeting of the British Association, recently held in Birmingham, the attention of the members was invited to a patent apparatus, invented by Mr. Foudrinier, for obviating the risks which attend the breaking of the ropes or chains attached to the corves or

cages in which the miners descend into and ascend from the pits. Such accidents not only cause destruction of human life, but in shafts which are fitted up with guides, according to the most improved practice, occasion considerable damage to the shaft-fittings. The object of Mr. Foudrinier's invention is to fix, in all such cases, the corve or cage firmly and instantaneously to the guide, through the instrumentality of self-acting springs, levers, and wedges, attached to the top and forming part of the cage. These come into action when disengaged through the breaking of the rope or chain,—that is, in the very instant at which the accident occurs. The apparatus is so admirably contrived, that, through the operation of simple mechanical principles, the tightness with which the wedges hold increases in proportion to the increase of weight in the cage. There is in mining operations another source of danger, in the liability of the load to be drawn up against the pulleys, through the negligence of the engineer,—an accident attended with next to certain death to the men, as well as great damage to the shaft. The risk attending such an accident Mr. Foudrinier also obviates, by attaching to the rope or chain a disengaging apparatus, such as that made use of in the pile-driving machine, the corve being, at the moment of disengagement, left affixed to the guides at a certain distance below the pulleys. In this case, also, the apparatus is self-acting. Mr. Foudrinier is known to have perilled his own safety in order to test the efficiency of his apparatus. At the Usworth colliery, in the county of Durham, where it has been in operation since the 16th of April last, it has more than once been subjected to very severe trials, and a number of colliery viewers and engineers having seen the cage, though loaded with two full tubs, and weighing about 2½ tons, stopped instantaneously upon the disengaging of the rope, have come forward to bear public testimony to the value and completeness of the invention. The apprehension which some persons had entertained with reference to the fall of a portion of the rope, when broken, on the top of the corve or cage, appears to have been removed by a communication from Mr. Elliot, the owner of the Usworth colliery, which was published in the *Mining Journal* of the 28th of July last. Mr. Elliot there states, that in the Usworth colliery, a broken rope, of about 200 fathoms in length, and weighing about 37cwt., had in that month fallen on a cage top there in use, consisting merely of a 3-inch Memel plank, without any injurious result. This he explained by the circumstance that the fall of the rope is distributed over several seconds of time, and that, consequently, the latter does not acquire the momentum which would be acquired by a mass of the same weight when descending in a compact and solid body. The numerous experiments made at Birmingham with this apparatus afforded the highest gratification to many of the distinguished persons who attended the meeting of the British Association; and Dr. Buckland and many other gentlemen expressed a high opinion of its value.—*London Times.*

USE OF PARACHUTES IN MINES.

It is well known that vertical ladders for descending into deep mines are very fatiguing, so that the miners prefer to trust themselves to baskets suspended by ropes, and in many cases the baskets are the only means provided for descending and ascending. But accidents frequently occur from the breaking of the ropes, in spite of all the precautions that can be taken to prevent it. The *Brussels Herald* states that some experiments have lately been made on a large scale in Belgium with a contrivance intended to remedy this evil. The basket or cuffat is so made, that, in case the rope breaks, it immediately springs open, forming a sort of parachute, which is held suspended in the air by means of the strong current which, it is well known, is always rushing up from mines, owing to the temperature below being higher than that above. The effect of this apparatus was shown before a numerous company, several miners intrusting themselves to the basket, which was so arranged that at a certain point the rope broke; they were sustained in the air by the open basket, so that the experiments were entirely satisfactory.

GREAT DAM AT HADLEY FALLS.

During the past year, a dam has been completed across the Connecticut River at Hadley Falls, 10 miles north of Springfield, Mass., which is believed to be the largest in the United States. It forms a portion of the works of a large manufacturing company, which is incorporated with a capital of $4,000,000. They own about 1,200 acres of land and the entire water-power, which is very great, as the fall of water in the river at that point is about 59 feet. A dam built, as is the present one, of wood, was carried away the day that the gates were first closed, in the fall of 1848, owing, as is supposed, to some peculiarity in the strata of the rock which forms the betl of the river. The present structure is 1,017 feet long, and is an improvement upon the old cribbing plan. It is built of solid timbers, 12 inches square, laid crosswise, one above another, with a pitch up-stream, and all bolted and pinned together, sunk to the average depth of 4 feet into the solid rock in the bed of the river, and there firmly secured. All the open space between the timbers is filled up with stones for 15 feet from the bottom, and a large bed of gravel is laid before the structure, to render it tight and firm. The width of the dam at the base is 90 feet, and its height varies with the bed of the river, from 28 to 32 feet. The slope from the top to the upper edge of the base is on the angle of 21½ degrees. The covering is of plank, 6 inches thick, bolted down to the timbers. The upper part and ridge are double-planked, and the ridge, which is pitched down-stream, is covered with thick boiler-plate, to protect it from the ice. The amount of timber in the dam is about 4,000,000 feet, and the pressure which the dam is required to sustain, when there is but two feet of water on the ridge, is upwards of 44,000 tons.

The abutments and bulkhead, which together occupy about 200

feet, are constructed of solid masonry. The gateways of the bulkhead, 13 in number, through which the water is let into the main canal, are 8 feet wide by 15 feet high, with double guard-gates, securely put in. A gate-house is to be erected on the bulkhead, of sufficient dimensions to cover the gates, and to contain the machinery for moving them.

The gates were first closed on October 22d, and the water began to run over the dam in 9 hours and 16 minutes from the time of closing. In the construction of the abutment, guard-gates, and lock-wall, at the head of the canal, there have been used 10,000 perches of stone (25 cubic feet to the perch). It is said that in peculiar states of the air the roar of the water at this dam has been heard for the distance of 40 miles; and in Springfield, ten miles distant, it is heard distinctly, and doors, whose latches allow them a little play, vibrate to its concussions, at the rate of 128 vibrations per minute.

To show the magnitude of the works of which this dam forms a part, we may mention that 70,500 perches of masonry have been laid, and 602,000 yards of earth and 50,000 yards of rock excavated, since the work was first commenced.

NEW SHIPPING-SIGNAL.

A NEWLY invented apparatus for the prevention of collision at sea during foggy and thick weather, when lights and other methods now in use are altogether unavailable, has been recently exhibited at Lloyd's Rooms, in Liverpool. The machine is extremely portable, occupying a space of about 2 feet square, and capable of being worked by one man, who, turning a cog-wheel acting on a force-pump, produces a volume of sound that will penetrate to a distance of several miles. It was highly approved of by many merchants, captains, and other nautical men, and it will answer, also, as a signal of distress for vessels, when in danger on a lee-shore or elsewhere.

INSTRUMENT FOR MEASURING A SHIP'S VELOCITY.

MR. ARTHUR HUSTON, Bristol, Maine, has invented a very simple machine, which, on deck or cabin, or any convenient place, points to a register marked with degrees to indicate the number of knots the vessel is making per hour or half-hour. The principle of it consists in a lever with a blade on its lower end, passing down on both sides of the keel as a resisting medium to the water, which, by a graduated spring on the upper edge of the lever, moves the lever backwards and forwards, according to the pressure of the water, and by having the pointer on the upper end, the velocity of the vessel is thus indicated on the dial. Two or more pointers may be placed in different parts of the vessel, connected to the top of the lever by wires, to register the velocity in different parts of the vessel at the same time.

LEE-WAY INDICATOR.

This contrivance, the invention of Mr. Wilder, of Detroit, is another of the instruments intended to show the lee-way or side-way drifting from her course which every ship makes, to a greater or less degree. All these inventions have hitherto been unsuccessful, but this seems to approach nearer to what is required. A tube about 4 inches in diameter passes down through the binnacle to the keel of the vessel, through which passes a rod, and to this a vane is attached, about 8 inches deep and 2 feet long. As this is in dense water, it will be operated on by any drifting of the vessel, which will be indicated by a needle at the top of the rod, which is placed upon a plate on which the degrees are marked. This plate can be most conveniently placed between the two compasses in the binnacle, and therefore directly in front of the helmsman. Should this invention answer the purpose intended, the latitude and longitude of a ship can be ascertained very nearly, without an observation of the sun, merely by calculating the "dead reckoning," or distance run by the log. Anything, however, projecting from the keel as this does, is very much exposed to be knocked off by whatever comes in contact with it.—*Detroit Bulletin.*

MACHINE TO INDICATE A VESSEL'S VARIATION FROM HER COURSE.

If we understand correctly the description of this contrivance, the slightest variation from the true course of the ship is marked so that the officer in command can at once detect any careless steering. It is the invention of Mr. A. E. Dayton, of St. Lawrence Co., N. Y., and is simply a new combination of the chemical telegraph. A small fillet of the chemical paper is combined with the compass, and it is drawn forward slowly by clock work. The fillet is marked with parallel lines, and a small steel point in connection with the wire of the battery rests on it. This will make a straight line always if the vessel does not diverge from her track, but every divergence of the vessel from her direct route will be indicated by the point marking either angular or curved lines on the fillet.

AIR-WHISTLE.

Mr. C. Daboll, of New London, Conn., has invented a whistle that speaks with a most "miraculous organ" whenever its services are required for the purpose of alarm or warning. It is designed for the use of vessels at sea or on the coast, as on our eastern shores, where dense fogs prevail, and vessels are liable to come in collision before they are conscious of each other's approach. Its great advantage is its power of communicating sounds for a distance of from 4 to 5 miles, far exceeding the largest bells. An experimental one has been placed on Bartlett's Reef, and the pilot of the Lawrence states that he has heard it when about 4 miles off from Bartlett's Reef, *against the wind,* which was blowing quite fresh at the time. This was on a *clear day, and* when the whistle was blown, at his request, and also

by advice of the inventor, so that the distance might be marked. It is probable that, under the same circumstances, the tones of a bell could not have been heard more than from one half to three fourths of a mile. The pilot of the steamer Knickerbocker reports that he *made the whistle*, during a dense fog, thirteen minutes' running-time of the steamer, before coming up with the station where it is located. He therefore must have been some four or five miles distant from it when he heard it.

This whistle consists of an air-chamber or condenser, of boiler-iron, sufficiently strong to resist almost any pressure, an air-pump, and a whistle similar to the ordinary ones used on locomotives. By means of the air-pump operating into this chamber, a pressure of air is obtained in it of any required amount,—say one, two, or three hundred pounds to the square inch. When the air is so compressed, it is made to operate the whistle by simply opening a valve, and gives a distinct, clear sound.

A memorial has been presented to the Treasury Department, signed by most of the commanders and pilots of the steamboats running through Long Island and Fisher's Island Sounds, setting forth the advantages to be derived to navigation from this whistle, and urging that it be introduced into the light vessels, and at all stations where the government intends to afford protection to navigation.

REPORT ON LIGHT-HOUSES IN THE UNITED STATES.

Mr. Pleasanton, the Fifth Auditor of the Treasury, has published a small pamphlet, containing a list of the light-houses, beacons, and floating lights of the United States, with a statement of their location, heights, distance at which they are visible in clear weather, &c. It is accompanied by three distinct and beautifully engraved lithographic charts. The first exhibits the light-houses and light-vessels on the American coast from Maine to Virginia inclusive. The second presents a similar exhibit of the coast from Virginia, exclusive, to Texas, inclusive, with the lights, of course, along the coast of Florida, and in the Florida Keys, &c. The third chart exhibits the position of the light-houses on the *Lake coast.* They are represented on the maps by red circles diverging into rays. There are 14 on Lake Michigan, 1 at the Straits of Michilimackinac, 7 on Lake Huron, 1 on Lake Superior, 2 on Lake St. Clair, 20 on Lake Erie, 13 on Lake Ontario and the St. Lawrence, and 3 on Lake Champlain.

The general list exhibits strong evidence of the energy of the bureau of the Fifth Auditor in the extension of the system. Up to the 1st of July, 1848, there were 270 light-houses, some of them *revolving*, varying in the time of their revolution; but most of them are *fixed* lights, differing in the height of the lanterns, and in the distance at which they are visible. The longest distance is 30 miles, on the highlands of Neversink, on the coast of New Jersey, there being two lights, one of them revolving.

The light-houses are so distributed, according to the necessities of the service, that there are 32 light-houses on the coast of Maine, 3 in

New Hampshire, 38 in Massachusetts, 9 in Rhode Island, 1 on Juniper Island in the State of Vermont, 11 in Connecticut, 41 in New York, embracing, probably, the Lake Coast, 7 in New Jersey, 2 in Pennsylvania, 8 in Delaware, 12 in Maryland, 8 in Virginia, 7 on the coast of North Carolina, 5 in South Carolina, 7 in Georgia, 14 in Florida, 3 in Alabama, 4 in Mississippi, 13 in Louisiana, 14 in Ohio (the Lake coast), 19 in Michigan (Lake coast), 1 in Indiana, 2 in Illinois, and 6 in Wisconsin (of course the Lake coast).

There are 32 floating lights dispersed along the Atlantic and Lake coasts, varying in the number and character of the lamps.

CONSTRUCTION OF THE CARYSFORT LIGHT-HOUSE.

We gather from a Philadelphia paper an interesting account of an iron light-house now being erected off the coast of Florida. It is preceded by a short history of iron light-houses in general. "The first iron light-house of which we have any account was erected in Jamaica, in 1841; in 1844 a second one was erected on the island of Bermuda, and in 1846 a third was built for Ceylon. All three of these were of cast-iron, and in the form of columnar towers, 80 to 90 feet high. The Jamaica light-house has been severely tested by earthquakes and lightning, and remains quite uninjured after a lapse of seven years, when, if the material had been brick or stone, it would have suffered serious injury, or perhaps destruction. Several iron light-houses have been erected on the Irish coast upon screw-pile foundations. This foundation consists of a series of massive pillars or piles of wrought-iron, each armed with a worm or screw of from two to four feet diameter. These piles are screwed into the shoal or sand-bank from a raft or from a temporary platform.

A capstan being fitted on to the head of a screw pile, manual force is applied, and as the men walk round with the capstan, the screw is slowly but surely inserted in the sand beneath the waters. When a sufficient number of these screw-piles are thus inserted in symmetrical order, and the heads of the piles framed together, it is evident we have obtained a footing or foundation on the shoal, which, while possessing enormous strength (from the nature of the material employed), offers but a very small surface of resistance to the waves as they dash furiously through this apparently frail structure,—and on this foundation we may erect a superstructure suitable in all respects for the purposes of a light-house.

A screw-pile foundation for a light-house was constructed last summer (1848) on the Brandywine shoal, with entire success, and withstood uninjured the effects of the vast fields of ice that formed in Delaware Bay last winter, and that must have been driven against the piles with prodigious force.

The Carysfort light-house is modelled on the plan of the screw-pile at least in respect to its foundation, which consists of nine piles of iron, arranged upon the angles and centre of an octagon. The intended site for this light-house is a coral reef, where the use of screw-piles would not be practicable, and where it becomes necessary to bore

into the coral before inserting the foundation-piles. As this species of rock is, however, too soft to bear the weight imposed upon each of the foundation-piles, an expedient has been adopted by which a larger area for support is obtained, and the weight of the entire structure made to rest on the surface of the rock. This is accomplished by connecting each foundation-pile with a large disk of cast-iron, and the disk resting on the surface, while the pile passes down through its centre 10 feet into the body of the rock, the two points of stiffness and support are duly achieved.

"The heads of the foundation-piles rises 15 feet above the surface of the reef, and are there framed together by massive horizontal ties keyed into appropriate sockets, from which rises a series of wrought iron pillars to the height of 30 feet, having an inclination towards the centre of about 10 degrees. On the heads of these pillars are fitted massive sockets, from which rises a second series of pillars, 33 feet long, and of less diameter, the heads of which are also fitted with sockets, that bear the third and upper series of pillars, 24 feet long. A central column rises from the centre foundation-pile to a level with the top of the upper series of pillars; and from this central column there radiate, at proper levels, iron girders of great strength, which, added to the horizontal ties extending from one pillar to another, form a combination so compact and stiff that no force of the wind, it is supposed, will ever disturb it.

"For the residence of the keepers of the light, a cast-iron dwelling, of a circular and conical form, is fitted to the above-described framework of pillars, ties, &c., at a point 35 feet above the level of the reef, and 20 feet above the highest tides. This dwelling consists of two stories. The lower one, being about 8 feet in height and 40 feet in diameter, is designed for the deposit of stores, the kitchen, &c. It is fitted with 8 windows, and 16 bull's-eyes,—the former for air, the latter for light. It contains 6 iron tanks, for water and oil. The upper story is divided into 6 rooms, with a hall in the centre, to allow a free ventilation in all the apartments. There is a door at each end of the hall, and a large window in each room. Surrounding this story is a gallery, exterior to the house, 5 feet in width, where the keepers may exercise.

"From the centre of the hall rises a spiral staircase to the top of the structure. This staircase is inclosed by an iron cylinder, the whole weight of which rests upon the roof of the dwelling-house. On the top of the structure is the watch-room, and lantern, or light-room, fitted to contain a catadioptric apparatus of the largest size, that will produce a light of the highest power. The diameter of the structure at the base is 50 feet, and 20 feet at the level of the watch-room floor. The height of the entire work above the surface of the reef will be 127 feet, and the height of the centre of the light 115 feet. The sight will be about 9 miles distant from the nearest land (Key Largo), and the depth of water on the site at low tide about 8 feet.

THE MINOT ROCK LIGHT-HOUSE IN BOSTON HARBOUR.

From the report of Captain W. H. Swift, of the Topographical Engineers, we derive the following account of the new light-house off Cohasset, in Boston Harbour. The rock selected for the site of the light-house is called the Outer Minot; at extreme low-water an area of about 30 feet in diameter is exposed, the highest point being about 3½ feet above low-water line. The rock is granite, with vertical seams of trap rising through it. The form of the light-house frame is an octagon, of 25 feet diameter at base. The structure is formed of 8 heavy wrought-iron piles or shafts, placed at equal distances from each other, with one also at the centre. These piles are forged in two pieces each, and are connected together by gun-metal sockets, the interior of which is bored, and the pile-ends are turned and secured to the sockets by means of large steel keys passing through the piles and the sockets. Above and below the joints or sockets, and connecting the middle pile with each outer pile, there extends a series of wrought-iron braces; and the outer shafts are connected together by similar braces, extending from one to the other, and thus the whole structure is tied together. At each of the angular points in the octagon, and at the centre, a hole of 12 inches in diameter and 5 feet in depth, is drilled in the rock; the outer holes with the inclination or batter given to the outer piles, and the middle hole vertical. The piles are of unequal lengths, the least length in the lower series being 35¼ feet, and the greatest 38¾. The piles in the upper series are of the uniform length of 25 feet each; the batter of the piles towards the centre brings the heads of the upper ones within the periphery of a circle of 14 feet diameter, and there, at an elevation of 60 feet above the base of the middle pile, the pile-heads are secured to a heavy casting or cap, to the arms of which they are securely keyed and bolted. The middle shaft is 8 inches in diameter at foot and 6 inches at top, and the outer shaft 8 inches at foot and 4½ at top, all being forged 10 inches in diameter at the point where they leave the surface of the rock, and tapering uniformly down to 8 inches in diameter in both directions, within a distance of 5 feet. The lower braces, placed 19 feet above the rock, are 3½ inches in diameter; the second series, 19½ feet above the first, are 3 inches in diameter, and a third series, introduced 8¼ feet below the cast-iron cap, to form the support of the floor of the store-room, is made of 2½-inch-square iron.

The outer piles being inclined towards the centre, and the piles and the braces being inflexible, it is clear that, so long as the braces remain in place, the pile cannot be withdrawn from the hole, for the whole structure acts as an immense "lewis;" either the braces must be ruptured, or the rock itself must yield, before a pile can be displaced. Upon the pile-heads are cast-iron sockets, furnished with arms 3 feet in length, pointing outwards. These sockets are keyed to the heads of the piles, and are bolted to the arms of the cap or spider, flush with its upper surface; thus giving a diameter of 20 feet from out to out. The object of the arms is to afford support for a gallery outside of the keeper's house, which is secured directly to the cap by bolts or

The keeper's house is octagonal in shape, and 14 feet in diameter; the uprights or stanchions are of cast-iron, and rest upon the cap immediately over the pile-heads, where they are secured with bolts and keys; these uprights are cast with double flanches, between which 2-inch planks, tongued and grooved, are fitted horizontally, and at right angles to these another series of planks are set on end or vertically, and, together, these form the side or frame of the house; upon this frame the roof is placed, and, finally, upon this the lantern is set up.

The rock is so exposed that the drilling of the holes occupied the most of two seasons, although machines were used; but these were several times washed from the rock.

The light is a fixed one, and the apparatus is composed of 15 brass lamps, with reflectors 21 inches in diameter. The framing of the lantern is of wrought-iron, and is a polygon of 16 faces; height, 6 feet 6 inches, furnished with cast-iron ventilator; the glass, French plate, 44 by 24 inches, and three eighths of an inch; the extent of illumination is 210 degrees. Thus the entire height of the structure is about 70 feet. The average weight of each complete shaft is about 8,200 pounds. The lantern and illuminating apparatus are about 4½ tons in weight.

NORWEGIAN WATER-TELESCOPES.

The water-telescope is an instrument three or four feet long, which the people of Norway have found of so great utility that there is scarcely a single fishing-boat without one, and which they carry in their boats with them when they go a-fishing. When they reach the fishing-grounds, they immerse one end of this telescope in the water, and look through the glass, which shows objects some ten or fifteen fathoms deep as distinctly as if they were within a few feet of the surface. When a shoal of fish comes into their bays, the Norwegians instantly prepare their nets, man their boats, and go out in pursuit. The first process is minutely to survey the ground with their glasses, and where they find the fish swarming about in great numbers, they give the signal, and surround the fish with their large draught-nets, and often catch them in hundreds at a time. Without these telescopes their business would often prove precarious and unprofitable, as the fish, by these glasses, are as distinctly seen in the deep, clear sea of Norway, as gold-fish in a crystal jar. This instrument is not only used by the fishermen, but is also found aboard the navy and coasting vessels of Norway. When their anchors get into foul ground, or their cables warped on a roadstead, they immediately apply the glass, and, guided by it, take steps to put all to rights, which they could not do so well without the aid of this rude and simple instrument, which the meanest fisherman can make up with his own hands, without the aid of a craftsman. This instrument has been lately adopted by the Scotch fishermen on the Tay, and by its assistance they have been enabled to discover stones, holes, and uneven ground, over which their nets travel, and have found the telescope answer to admiration, the minutest object in twelve feet

of water being as clearly seen as on the surface. We see no reason why it could not be used with advantage in the rivers and bays of the United States.

CORKS MANUFACTURED BY MACHINERY.

AMONG the articles exhibited at the display, just closed, of French domestic products, we remarked corks for bottles, which were made by machinery. Numerous and costly experiments, to supersede manual labor, had entirely failed. But Messrs. Duprat and Co., of Castres, devised and executed an apparatus, by which, at their great manufactory of corks, they turned out a hundred thousand daily, of the best formation and finish, easily to be distinguished from those of handicraft in common use. By multiplying the machines, the manufacturers could meet any amount of demand. Hitherto, for the essential operation,—the rounding,—workmen of special skill and practice were indispensable, and received wages of four francs per diem for the thousand corks they were able to furnish. By the machine called *La Tourneuse*, plied with little fatigue, by a woman or child, the supply is 25,000 per day.—*French Journal.*

ICE MADE BY MECHANICAL POWER.

REPORTS have been circulating, for some time past, of an invention for manufacturing ice by some mechanical means; but the idea has met with almost universal ridicule, so that we were very much surprised, a short time since, when a friend from the South informed us that there is a company now in existence in New Orleans, who propose to manufacture ice; and he further informed us that he had seen beautifully clear lumps, four feet square, manufactured by the company. He added, that, even if they failed in making ice in large quantities, there was no doubt but that they could produce currents of very cold air, which could be introduced into dwellings in summer, for the purpose of cooling them, and preventing disease.

We find in a late number of the *Scientific American* a letter from New Orleans, in which the manner of proceeding is partially detailed. The writer says, that the invention is not purely mechanical, but is based upon both mechanics and chemistry. It consists essentially of a force-pump, in which air is divested of latent heat by mechanical compression, and an engine, in which the same air is made to act expansively, and in the process to absorb from the water to be frozen the heat due to its increase of volume. But there are several auxiliary agents for giving this simple contrivance its greatest effective utility. Thus, by an obvious arrangement of attaching the pump and engine to the opposite ends of a common beam, the power consumed in condensing the air in the pump is, to a considerable degree, recovered in its expansion in the engine. At the same time, the heat evolved by the compression of the air is extinguished by a jet of water, thrown into the body of the force-pump by means of a smaller pump; while the heat necessary to impart to the expanding air the elasticity and me-

chanical force due to its quantity and volume is furnished through a similar pump, which takes from the cistern a portion of the liquid, and, after injecting it into the expanding air in the engine, returns it to the same cistern. This cistern thus operates as a reservoir of cold, and as the sufficient means of abstracting heat from water, which is to be converted into ice. It is proposed to use the same air over and over again, and thus the inventor attains the object of employing air which previous condensation has deprived of heat, and subsequent expansion has left at a lower temperature than the atmosphere. The present imperfect machine has lowered a large quantity of matter from 90° Fahrenheit to 5° below zero, and maintained it at the latter temperature for a long time, with but little cost of power; but a new machine is now building, which it is supposed will succeed still better, as some defects, natural to a new and original contrivance, have been obviated in this second one. Ice can, it is expected, be made by this process at a cheaper rate than it could be imported from the Northern States.

GUTTA-PERCHA TUBING.

A SERIES of interesting experiments has just been concluded at the Birmingham Water-works, relative to the strength of gutta percha tubing, with a view to its applicability for the conveyance of water. The experiments were made upon tubes of three quarters of an inch in diameter, and one eighth thick, of gutta-percha. These were attached to the iron main and subjected for two months to a pressure of 200 feet head of water, without being in the slightest degree deteriorated. In order to ascertain, if possible, the *maximum* strength of the tubes, they were connected with the Water Company's hydraulic proofing-pump, the regular load of which is 250lbs. on the square inch. At this point they were unaffected, and the pump was worked up to 337lbs., but, to the astonishment of every one, the tubes still remained perfect. It was then proposed to work the pump up to 500lbs., but it was found that the lever of the valve would bear no more weight. The utmost power of the hydraulic pump could not burst the tubes. The gutta-percha, being slightly elastic, allowed the tubes to become a little expanded by the extraordinary pressure which was applied, but on its withdrawal they resumed their former size.—*Athenæum, August.*

CORDAGE-MACHINE.

THE New Bedford Cordage Company have in operation a machine for manufacturing "shrouds" for ships, which effects a great saving in time and labor over the old mode. By it, a length of shrouding 90 fathoms long, consisting of four strands, and weighing a ton, can be completed and reeled in 33 minutes, requiring only the labor of two men and two boys, whereas, but a few years since, it would have taken thirty men half a day. It is claimed that superior strength and durability are *also gained* by this process, as in "laying" the

strands they are allowed to remain undisturbed till the rope is finished, which maintains an equal tension to the strands, and of course increases the strength.

KYANIZED ROPE.

CONSIDERABLE attention has been excited by the Maysville establishment for manufacturing hemp without rotting. Frequent attempts before have failed on account of inefficient machinery, and especially on account of the great liability of this kind of hemp to most offensive putrefaction and speedy decay. Now these difficulties seem to be entirely overcome. The hemp is broken out and cleaned without making tow or waste, and the product is carried through a chemical process called *kyanizing*, by which it is rendered indestructible from ordinary exposure to weather. This kyanized rope is said to be superior to the Manilla for river purposes, being stronger, more flexible, more durable, wearing smoother, and being more pleasant for boatmen to handle. At the same time, it must be admitted, that before it is used it does not look as well as Manilla, and there is no other cordage in the world that does. It is said to improve in appearance, however, by wear, while the Manilla *frays down* and wears rough. Here, then, is a use American hemp is applied to, which heretofore required a foreign article. The kyanized rope and kyanized bagging, too, must probably come into use in covering cotton-bales. The dew-rotted rope and bagging gives way too soon, by the exposure which a great deal of the cotton is subjected to, and it arrives at its place of destination in bad order.

It is stated that hemp can be worked up into both rope and bagging so economically and perfectly as to render it certain that the usual manner of working it cannot be much longer used,—that rope and bagging can be made cheaper in this way than by the usual mode.

Some trials have lately been made at Cincinnati, in order to test the comparative strength of Manilla and this new kyanized rope. A small Manilla rope of the best quality, of Boston manufacture, broke after sustaining a weight of 1,520lbs. The kyanized rope manufactured in Maysville was found to sustain a weight of 2,320lbs. before breaking. On a second trial, a Manilla rope of the same size sustained 2,200lbs., and the kyanized rope 2,410lbs. Two trials were then made with a larger size of the Manilla rope, manufactured by Boute, which parted first, with a weight of 2,840lbs., and afterwards with one of 2,796lbs. The large-sized kyanized rope sustained the weight of 3,220lbs. before parting. The average difference in favor of the kyanized unrotted hemp-rope was, on the first trial, 500lbs., and on the last one, 400

WOVEN IRON.

MESSRS. WICKERSHAW & WALKER, of Philadelphia, have a patent right for the manufacture of *woven* iron. This improvement does

away with the necessity of rivets for the purpose of fastening iron-work together, where it is used for grating of any description. The manufacturers are enabled to weave iron as large as railroad bars, or the smallest description of wire.—*Journal of Commerce.*

SHEET-IRON PIPES.

SHEET-IRON pipes of a new manufacture have lately been introduced into England, from France, where they have been in use for several years. They are made of sheet-iron, which is bent to the required form and then strongly riveted together, after which they are coated with an alloy of tin, and the longitudinal joints are soldered so as to render them both air-tight and water-proof. In order to give them more stiffness, they are next coated on the outside with asphalte cement, and, if they are intended to be used as water-pipes, the inside is also coated with bitumen, which resists like glass, the action of acids and alkalies. They are so elastic that they will bear a considerable deflection without injuring the pipes, or causing any leakage at the joints. The vertical joints screw together in the same manner as cast-iron gas-pipes. These pipes have been used for water, for gas, and for draining, and are found to be more economical than cast-iron, besides being less liable to leak, and for water-pipes they are more healthy than the common ones.

CAST IRON PIPES.

MR. THOMAS J. LOVEGROVE, of Baltimore, has made an important invention in the manufacture of iron pipes, whereby much time and expense are saved. It is an ingenious application of the known effect of centrifugal force, and it will do away with the old and laborious plan of making moulds for each pipe. Any sort of pipes can be made in this way.

By the ordinary mode of casting pipe, it is necessary to make a sand-mould for every separate piece of pipe, and a "core," which is formed by wrapping hay around a rod, this again being coated carefully with clay to preserve the tubular or hollow form of the pipe. The time thus occupied may be easily imagined, and the consequent gain that must necessarily attend any plan by which all this is dispensed with.

The invention of Mr. Lovegrove consists of an iron mould, suspended horizontally, and arranged for the introduction of the melted metal by means of a trough at one end. As the metal is introduced, a slight depression at one end is effected by means of suitable tackle, and the revolution of the mould immediately commences; by the time all the metal is introduced, the mould is elevated to its true position, the gravitation having carried the fused metal to the end of the mould, and it suddenly revolves for about half a minute with considerable velocity, distributing the metal equally to the surface, throughout the entire length of the mould, from the centrifugal force of the revolution. The vacancy in the centre is of course regulated

by the amount of metal,—the pipe being made of any degree of thickness required.

The effect within the mould is quite singular, and very distinctly perceived during the operation. As the revolution commences, nothing is to be seen within but a confused mass of molten metal apparently occupying the whole of the interior; suddenly, but noiselessly, with a discharge of flame, the metal has taken its place at the surface of the mould, is revolving truly with it, and in the twinkling of an eye the perfect tube is seen within. In a few seconds, the revolution ceases, the mould is separated, the upper half being hoisted off, and the pipe removed. There is no adhesion, the pipe in the instant of cooling undergoing contraction sufficient to obviate this, were there no artificial protection against it. The time occupied from the tapping of the furnace to the lifting the perfect pipe from the mould was precisely two minutes. And it is obvious that, with a range of two or three moulds in operation, pipe could be turned out as rapidly as the metal could be drawn from the furnace.

But the invention will not be confined to the mere casting of iron pipe. It is evidently applicable in various departments throughout the whole range of the mechanic arts. It is not limited in its effects either, as we understand it, to a mere smooth surface, but while retaining its circular form it will adapt itself to every variety of external shape and ornament.

ON THE MANUFACTURE OF THE FINER IRONS AND STEEL.

Mr. Greener has read a paper before the British Association, "On the Manufacture of the Finer Irons and Steel, as applied to Gun-Barrels and Swords." The first innovation on the old principle of manufacturing gun-barrels entirely from old horse-nail stubs was caused by the introduction of the so-called Damascus iron, which is formed of alternate layers of steel and iron, fagoted, drawn down into rods, then tortuously twisted, and when welded into barrels, it forms the Damascus barrel. The success of this experiment, both in beauty and strength, was so great, as to be under-estimated at 50 per cent., as compared with the strength of stub-twist iron. The next experiment was to blend more intimately steel with horse-nail stubs, in proportion of one to two of the latter. The next and most important improvement was in the manufacture of gun-barrels from scrap-steel entirely, and for this purpose old coach-wheels were generally in request. By clipping these into pieces, cleansing them, and welding in an air-furnace, a metal is produced, which surpasses in tenacity, tenuity, and density any fibrous metal ever before produced. Its tenacity, when subjected to tension in a chain-testing machine, is as 8 to 2½ over that of the old stub-twist mixture. No gunpowder yet tried has the power to burst barrels made from it, when properly manufactured. These experiments have induced others on a more extensive scale; to effect this, ingots of cast-steel were taken from the mill, made to No. 3 in the scale of carbonization. These, after *rolling* into flat bars, were clipped into small pieces, immediately

mixed and welded in the air-furnace, drawn down into rolls, and re-fagoted; these are subsequently drawn down, and are then ready for being made into gun-barrels, either with or without spirally twisting them; to form Damascene barrels from this is perfectly safe. The manufacture of swords is another article to which this improvement is applied. All Mr. Greener's investigations tend to satisfy him that it is in this way that the Arabs produce their finely-tempered Damascus swords; namely, using two steels of different carbonization, mixing them in the most intimate manner, and twisting them many fantastic ways, but preserving method in their fancy. Tempering by crystallizing the steel, as is ordinarily done, is far from the wisest way. The Damascus blade in its fibrous state, or hammer-hardened, is more difficult to break, by 100 per cent., than the best English-made blade. Temper it in the same way, however, and it shows no greater tenacity than our own. From these and other facts, the conclusion may be drawn, that swords constructed of dissimilar steel, tempered by condensation of its fibres, either by repeated rollings, hammerings, or in any other way, are the best.—*Athenæum, for September.*

CHAIN-LINKS FOR CABLES, ETC.

SOME experiments have recently been made with a view of testing the power of links for mooring-chains, cables, and other purposes, formed on the principle of Mr. Price, a gentleman already known among scientific men as the inventor of improvements in anchors. The object of the inventor is to lessen the expense and weight of chains as at present constructed, by doing away the stud or crossbar of the link, and making the link with straight or parallel sides, and not of the present oval shape; his principle being that, the fibre of the iron being kept straight, it will sustain or resist a much greater weight, or strain, than when force is exerted against it transversely. The test was completely satisfactory; a link of iron, seven eighths of an inch in diameter, with parallel sides, 3 inches in length, and 2¼ in breadth, without a stud, not breaking till a strain of 18 tons was put on it, being 8¼ tons beyond the government proof.—*London Paper.*

THE POWER OF IRON TO RESIST COMPRESSION AND EXTENSION.

WHILE making his plans and estimates for the Britannia Tubular Bridge over the Menai Straits, Mr. Stephenson, the engineer, caused several trials to be made in order to ascertain some facts which were deemed important. These are well described by a writer in a late number of the *London Quarterly*, from which we make considerable extracts, as the results are new and of great importance.

"One of the most interesting and important results of the preliminary investigations so ably conducted by Mr. Fairbairn and Mr. Hodgkinson, was the astonishing difference found to exist between the power of cast and that of wrought iron to resist compression and extension. From the experience which engineers and builders had ob-

tained in imposing weights upon cast-iron girders of all shapes and sizes, it had long been considered almost a mechanical axiom, that iron possessed greater power to resist compression than extension; whereas Mr. Fairbairn's experiments, to his surprise, as well as to that of all who witnessed them, most clearly demonstrated that, after bearing a certain amount of weight, the resisting properties of cast and of wrought iron are diametrically opposite; in short, the results, in figures, prove to be nearly as follows:—

"Cast-iron can resist, per square inch,

Compression of from 35 to 49 tons.
Extension of " 3 to 7 "

"Wrought-iron can resist, per square inch,

Compression of from 12 to 13 tons.
Extension of " 16 to 18 "

"The unexpected results thus obtained were of incalculable practical value, for, if the preliminary experiments proposed by Mr. Stephenson had not been made, all the eminent engineers and mathematicians of the present day would, on the correct principle of everywhere adjusting the thickness of iron to the force it has to resist, have erroneously concurred in recommending that the proposed wrought-iron tubes for crossing the Conway and Menai Straits should be constructed stronger at bottom than at top, instead of, as it appears they ought to be, stronger at top than at bottom, in consequence of which error the aerial gallery would have been improperly weakened in one part, by an amount of iron which would have unscientifically overloaded it at another.

"By continuing, with great patience and ability, the experiments above referred to, it was finally ascertained that the relative strength of wrought-iron in the top and bottom of the tubes should be in the proportion of about 5 to 4; and whereas, had they been constructed of cast-iron, these proportions would have been reversed in the higher proportion of nearly 5 to 1, it may reasonably be asked why, if the latter bears compression so much better than the former, it was not selected for the top of the tube? In theory, this adjustment of the two metals to the force which each was peculiarly competent to resist would have been perfectly correct. It, however, could not practically be effected, from the difficulty of casting as well as of connecting together plates 10 and 12 feet in length, of the very slight thickness required. Mr. Stephenson, therefore, adhered to his determination to make the whole of his aerial galleries of wrought-iron; and we may here observe, that, to ensure the public from accident, he further resolved, that the amount of the force of extension upon them should be limited to only one third of their power of resistance, that of compression to one half,—the reason of the difference being that, inasmuch as any little flaw in the iron would infinitely more impair its power to resist extension than compression, it was evidently safer to approximate the limits of the latter than of the former.

"As the exact strength of a hollow wrought-iron tube, such as was proposed, was unknown to engineers, it was deemed necessary by *Mr. Stephenson* that its form, as well as the disposition of its mate-

rials, should be correctly ascertained. This portion of the investigation Mr. Fairbairn and his colleagues conducted by subjecting tubes of different shapes to a series of experiments, the results of which were briefly as follows:—1. Cylindrical tubes, on being subjected to nine very severe trials, failed successively by collapsing at the top, or, in other words, by evincing inability to resist compression; the tube losing its shape, gradually became elongated, or lantern-jawed, while the two extremities were observed to flatten or bulge out sideways,—besides which, the ends, which for precaution's sake rested in concentric wooden beds, invariably bent inwards. 2. Elliptical tubes, with thick plates riveted to the top and bottom, had been particularly recommended for experiment by Mr. Stephenson. These tubes, under heavy pressure, displayed greater stiffness and strength than round or cylindrical ones; but, after being subjected to a variety of torturing experiments of a most ingenious description, they all evinced comparative weakness in the top to resist compression. They likewise exhibited considerable distortions of form. 3. A family weakness in the head having been thus detected in all models circular at bottom and top, rectangular tubes were in their turn subjected to trial. As they at once appeared to indicate greater strength than either of the other two forms had done, a very elaborate and interesting investigation was pursued by Mr. Fairbairn, who, by the light of his experiments, soon satisfied himself of the superiority of this form over the other two; and every successive test confirmed the fact.

"The following is an abstract of the important result of about 40 experiments made on the comparative strength of circular, elliptical, and rectangular tubes:—Circular, 13; Elliptical, 15; Rectangular, 21.

"As soon as the rectangular was, by the investigation, clearly ascertained to be the best form of hollow tube that could be selected, the next important problem to be determined by experiment was, what amount of strength should be given to it, or, in other words, what should be the thickness of its top and bottom, in which, as we have shown, consisted its main power. The investigations on this subject soon demonstrated that if, instead of obtaining this thickness by riveting together two or three layers of plates, they were, on the principle of the beam itself, placed in horizontal strata a foot or two asunder,—the included hollow space being subdivided by small vertical plates, into rectangular passages or flues extending along the whole top as well as bottom of the tube,—an immense addition of strength, with very nearly the same weight of material, would be obtained. This adaptation proving highly advantageous, it was deemed advisable that further experiments should be made by Mr. Fairbairn and his colleagues, to determine finally the precise forms and proportions of the great tubes. For this object an entirely new model-tube, one sixth of the dimensions of the intended Britannia Bridge, was very carefully constructed; and the cellular tops and bottoms thereof, as well as the sides, were subjected to a series of experiments, until the exact equilibrium of resistance to compression and extension, as also the variations in the thickness of the plates in the several parts of the

tube as they approached or receded from different points of support, was most accurately ascertained. In these, as well as in all the previous experiments, the trial tubes were loaded till they gave way. From the fibrous nature of wrought-iron, as compared with the crystalline composition of the cast metal, the tendency to rupture in most of these experiments was slow and progressive. Destruction was never instantaneous, as in cast-iron, but it advanced gradually; the material, for some time before absolute rupture took place, emitting an unmistakable warning noise.

"Although it can mathematically be shown that the two sides of a thin hollow tube are of but little use except to keep the tops and bottoms at their duty,—the power of resistance of the latter being, however, enormously increased by the distance that separates them,—it was nevertheless necessary to ascertain the precise amount of lateral strength necessary to prevent the aerial gallery writhing from storms of wind. The riveting process was likewise subjected to severe trial, as also the best form and application of the slender ribs, termed 'angle-irons,' by which not only the plates were to be firmly connected, but the tube itself materially strengthened,—in fact, the angle-irons were to be its bones, the thin plate-iron covering being merely its skin.

"Mr. Stephenson had two main objects in instituting the investigations we have detailed. First, to determine by actual experiment what amount of strength could be given to his proposed galleries; and secondly, of that maximum how much it would be proper for him to exert. And as his decisions on these subjects will probably be interesting to our readers, we will endeavour very briefly to explain the calculations on which they appear to have been based.

"As a common railway train weighs upon an average less than a ton per foot, as the greatest distances between the towers of the Britannia Bridge amount each to 460 feet, and as it is a well-known mathematical axiom among builders and engineers, that any description of weight spread equally along a beam produces the same strain upon it as would be caused by half the said weight imposed on the centre, it follows that the maximum weight which a monster train of 460 feet (an ordinary train averages about half that length) could at one time inflict on any portion of the unsupported tube would amount to 460 tons over the whole surface, or to 230 tons at the centre. Now, to insure security to the public, Mr. Stephenson, after much deliberation, determined that the size and adjustment of the iron to be used should, according to the experiments made and recorded, be such as to enable the aforesaid unsupported portions of the tube (each 460 feet in length) to bear no less than 4,000 tons over its whole surface, or 2,000 tons in the centre, being nine times greater than the amount of strength necessarily required; and as the results of the searching investigation which had been instituted incontestably proved that this Herculean strength could be imparted to the galleries without the aid of the chains, which even as an auxiliary, had been declared unnecessary, —and as Mr. E. Clark had very cleverly ascertained that it would be cheaper to construct the tubes on the ground than on the aerial

platform, as first proposed,—Mr. Stephenson determined, on mature reflection, to take upon himself the responsibility of reporting to the directors of the Chester and Holyhead Railway that this extra catenary support which would have cost the company £150,000, was wholly unnecessary. Indeed, such was the superabundance of power at his command, that, without adding to the weight of the rectangular galleries, he could materially have strengthened them by using at their top and bottom circular flues instead of square ones, which, merely for the sake of cleaning, &c., were adopted, although the former were found on experiment to bear about 18 tons to the square inch before they became crushed, whereas the latter could only support from 12 to 14 tons.

"But the security which Mr. Stephenson deemed it necessary to insure for the public may further be illustrated by the following very extraordinary fact. It has been mathematically demonstrated, as well as practically proved by Mr. Fairbairn, that the strain which would be inflicted on the iron-work of the longest of Mr. Stephenson's aerial galleries, by a monster train sufficient to cover it from end to end, would amount to six tons per square inch, which is exactly equal to the constant stress upon the chains of Telford's magnificent suspension Menai Bridge when it has nothing to support but its own apparently slender weight."

NEW METHOD OF SMELTING IRON.

Mr. M. Smith Salter, of Newark, N. J., has obtained a patent for a new method of making iron direct from the ore, with anthracite or bituminous coal, by a single process. By means of this remarkable invention, Mr. S. proposes to make wrought-iron at a cost of $25 to $30 per ton,—at least half the usual cost. His furnace has three combined chambers, one above the other, and all actuated by the same fire. The upper chamber is used for deoxidizing the ore,—impurities, such as sulphur, &c., being carried off at a low temperature,—the middle chamber for fluxing and working, and the lower chamber for reducing and finishing. The metal is taken from the last named to the hammer or squeezers. The whole time occupied in this process, from the time the ore is put into the furnace until finished by the hammer, is only two hours. One of his furnaces is now in operation at Boonton, in Morris County, N. J. Perhaps a more important invention—if fuller experiments should verify present anticipations—has not been introduced in many years.

IMPROVEMENTS IN PUDDLING IRON.

In the usual mode of puddling iron, the furnace is prepared by the introduction of roughly pulverized iron ore, or scoria, which is accumulated against the sides; this defends the plates, bridges, and bottom from the action of the melted iron; but a portion of it will collect in the interstices between the particles of scoria, from which it cannot be separated, and a loss of iron is the result. An improved method of

preparing the puddling-furnace has been patented by Mr. G. Williams, of Tipton. It consists in reducing the iron ore, or scoria, to a finely pulverized state, mixing the same with water, which is then tempered to the consistency of clay, and moulded into bricks or suitable-shaped pieces. These are used to line the interior of the furnace, cementing them together with a mortar or cement formed by mixing powdered iron ore, or scoria, with water. The paste or clay may also be formed into slabs or plates, and the patentee does not confine himself to scoria, but uses other fire-resisting substances to line the puddling furnace.—*London Times.*

IMPROVEMENTS IN MANUFACTURING BAR-IRON.

A PATENT has recently been taken out in England for an improvement in the manufacture of wire-rod and horse-nail-rod iron, by which the rod, before being cut into billets, is submitted to the action of a die or draw-plate, called a cleanser, which removes the scale from the surface, obviating the necessity of burning it off. The machine consists of two plates movable in a vertical slide; in the under edge of the upper plate and the upper edge of the under one, one or more grooves are made, which correspond in form with the section of those in the last pair of the rolls to which the bar is to be subjected, which are generally rectangular, or of a V form, for this kind of iron. The grooves in the plates are so made that, when the two are brought together, they form apertures corresponding to the sectional form of the bar-iron as it comes from the rolls. The cleanser is placed in front of the last pair of rolls, and its V grooves are caused to stand exactly opposite a corresponding number of grooves at the finishing end of the rolls. The iron is refined, and then hammered in the usual way into a bar 5 or 6 inches square in the section; it next passes through rolls until it becomes 1¼ inch square, after which it passes the cleanser, which clears it of all scale, and then it goes through finishing-rolls, and may be cut into billets to form bars in the usual way.

IRON FOR SUSPENSION-BRIDGES.

MR. THOMAS HOWARD has recently read before the London Society of Civil Engineers a paper on the rolling of bars for suspension-bridges, in which he gives a description of a new mode of manufacturing iron for this purpose. By the usual process the head or end of the link out of which the eye or hole for the connecting-pin is bored, has sometimes been welded on to a parallel rolled bar, and sometimes been hammered into the required form; but both these methods are objectionable, owing, in the former case, to the insecurity, and in the latter to the tediousness and expense. By the new method the bars are rolled at once into the requisite form in the following manner. The shingle or fagot of iron is first passed lengthwise at a welding heat through grooved rollers in the usual way, after which, before being drawn down to the intended thickness, it is carried to rollers which have bosses, or increased diameters, at the places corresponding to the

heads to be produced, and is there passed to and fro between the rollers across the breadth of the bar, thus receiving a pressure only at the enlarged part of the rollers, which gives the necessary increase of breadth at the heads. It is then taken to plain finishing-rollers, and drawn out longitudinally in the usual manner, until it attains the proper length and thickness. After this the heads are trimmed to the exact dimensions by machinery, and the holes are drilled for the pins.

The chains of the bridge over the Danube at Pesth, which has so satisfactorily withstood the heavy strain brought upon it by a retreating army, were constructed on this plan, as have been the chains of several other suspension-bridges.

INVENTION FOR THE MANUFACTURE OF STEEL.

THE *Practical Mechanic's Journal* furnishes a description of an invention relating to the process of refining metal, and forcing currents of atmospheric and gaseous air during the process, so as to convert it into steel; and also to prepare the metal previous to submitting it to the process of conversion into steel. The apparatus consists of the converting-furnace, to the *tuyère* of which a blast-pipe is attached formed into three passages, provided with valves for regulating the air-currents. Two of the passages communicate with two iron receptacles in front of the converting-furnace, the centre passage passing between them and to the front of the receptacles, which latter are provided with gratings, and ash-pits beneath, and with covers for closing them. The process of converting the metal into steel by this apparatus consists in allowing the air to pass into the two passages of the blast-pipe communicating with the receptacles, which are filled with charcoal. The charcoal is then ignited and the receptacles closed by means of the covers; the air thus passed through the receptacles is formed into carbonic oxide and enters the *tuyère* of the converting-furnace, where it is mixed with such a quantity of atmospheric air from the centre passage as may be judged desirable; though the patentee states that a large quantity should generally be avoided. By means of the valves, the quantity of gaseous or atmospheric air can be regulated by the operator. To prepare the metal for the process of conversion, if it be pig-iron, it is to be smelted sufficiently in a cupola-furnace, to which the apparatus described is applied; but if it be wrought-iron, a plumbago crucible is used, in which the metal is to be placed, being properly stratified with charcoal or carbonaceous material.

IMPROVEMENTS IN THE MANUFACTURE OF METALLIC COMPOUNDS.

WE find in Messrs. Barlow and Payne's *Patent Journal* an account of a patent recently taken out in England for some new metallic compounds. 1. The inventor produces a metal equal to refined iron by taking one twentieth of scrap malleable iron and placing it in the hollows of the pig-metal beds in the smelting, in which case the pig metal envelops *the wrought iron*, which loses its tenacity, and becomes

more brittle and steely. After this the whole mass is thoroughly puddled, and it comes out the best refined iron. Scrap-iron has been mixed with cast-iron before, but this smelting of the mass in the puddling-furnace is an improvement. 2. Another plan is to introduce the scrap malleable iron into the puddling-furnace, and then to run in the molten cast-iron from the smelting-furnace, before the scrap-iron is thoroughly smelted. The smelted iron has before been run directly into the puddling-furnace, but not mixed with the scrap in this manner. The inventor states that one fifth of scrap mixed with rich pig iron produces an article of iron of great ductility and fibrousness, which may be readily worked under the hammer or between the rolls. For tires of wheels and the surfaces of rails, the scrap-steel mixed with the cast-iron is a great improvement. By mixing one hundredth part of block-tin with the cast and scrap iron in the puddling-furnace, he produces a metal of smooth exterior, very hard, but which can be wrought by the hammer or rolls. The addition of zinc or its oxides in the puddling-furnace produces a bright-colored metal with a clean surface, which is very ductile and fibrous. To make a hard, steely iron, suited for wheel-tires and rails, he introduces black oxide of manganese into the puddling-furnace, mixing it well with the metal.

TO ENAMEL IRON.

The best and latest process for this purpose is the following. The articles to be enamelled should be first thoroughly cleansed, and then they are ready to receive the first coat, which is made of 100 parts of calcined flint, ground to a fine powder, mixed with 75 parts of fine-grained borax. This mixture is fused together, and when cooled is ground with 22 parts of potter's clay in water until it is of such consistency that, when an article to be glazed is dipped into it, a coating of about one sixth of an inch is retained. After this is done, the article is put on one side to allow the composition to "set," as it is technically called. But while it is yet moist, a composition containing 100 parts of cornish-stone, or red limestone, ground fine, 117 parts of borax, also pulverized, 35 of soda-ash, 35 of saltpetre, 35 of sifted lime, 50 of white glass, well pounded, and 13 of white sand, is carefully sifted over the surface to produce the glaze. These materials must be well mixed and burned in a crucible, and when cool, ground to a fine powder, after which they should be washed and dried. About 45 parts of them are mixed with one part of soda-ash in hot water, being well stirred together and then dried in the oven. The mixture is then ready for use. After the articles have been dusted over with this, they are placed in the oven of a stove, and kept at a temperature of 212° till the composition is dry, when they are placed in a kiln or muffle, and submitted to a sufficient degree of heat to fuse the glaze. If the glazing is not found perfect all over, the articles can be moistened with salt and water, and the glazing-powder sifted over them again, after which they must be subjected to the heat of the kiln again.—*Scientific American.*

METHOD OF SOLDERING CAST-IRON WITH WROUGHT-IRON.

THE following process has been recommended for this purpose. First, melt filings of soft cast-iron with calcined borax in a crucible; then pulverize the black vitreous substance which is thereby produced, and sprinkle it over the parts which are intended to be united; after which heat the pieces of cast and wrought iron, and weld them together on an anvil, using only gentle blows. This method is peculiarly applicable for the manufacture of iron articles which are intended to be made red-hot, and are required to be impervious to fluids or liquids, as such a result cannot be obtained by simple fastening.—*Technologiste.*

CAST ZINC IN DECORATION.

M. GEISS, of Berlin, has been exhibiting specimens of zinc used for architectural and decorative purposes in a mode not hitherto employed in England—namely, *cast.* It appears that for seventeen years, zinc has thus been used in Berlin for architectural purposes, that is, for all exterior as well as interior ornamental parts of buildings, which, by casting, can be produced in the sharpest forms, and are said to be at the same time capable of resisting all influence of the weather.

The late distinguished architect, Schinkel, thus writes on the subject:—"The cast metal offers particular advantages from its great strength in comparison with rolled zinc, from its being less subject to influence of temperature, and from its capability of receiving the finest impressions, when cast, for which reasons it seems well adapted for all plastic works of art. We see, therefore, already large statues, copies of antiques, in the factory of M. Geiss, at Berlin, executed in the most elaborate style; to which statues, by a precipitate of copper, an excellent imitation of copper can be given. All ornaments of carved work, and projecting members, forming perforations, and crowning members, can be executed of this metal in the easiest manner. At the same time the more important parts of building can be made very cheaply and durably. We have recently finished a large restoration of our University, in which about 1,600 feet of cornice have been cast in zinc, which was fastened to an iron framework, and which, instead of sixteen dollars per foot if in stone, cost in zinc only nine dollars, including the iron framework.

"The many advantages which zinc offers for the construction of furniture, as vases, candelabra, basins, &c., &c., which in the open air are less exposed to damage than stone, and for the clothing of rough iron supports, with the elegant forms of columns and consoles, dressings for doors, and richly ornamented architectural members, show clearly the extent of its usefulness, and will render it in future indispensable for architecture, contributing at the same time more and more to the extension of architecture itself."—*English Paper.*

IMPROVED MODE OF TEMPERING EDGE-TOOLS.

For heating axes, or other similar articles, a heating-furnace is constructed in the form of a vertical cylinder, the exterior being made of sheet-iron, lined with fire-brick, 4 feet 8 inches in diameter. In the interior of this cylinder four fire-chambers are formed, the inner wall of each being 18 inches long, 4 from front to back, and 4 deep, forming in the whole a circle 3 feet 4 inches in diameter; under each there are grate-bars, and air is supplied through a pipe connected with a blowing apparatus. A circular table of cast-iron is made to revolve slowly on a level with the upper part of the chambers, and when the articles are to be heated, they are placed upon the table with their steeled parts projecting so far over its edges as to bring them directly over the centre of the fire, and the table is kept slowly revolving. The hardening-bath consists of a circular vat of salt water, within which, a little above the surface of the liquid, is a wheel mounted horizontally, with a number of hooks around the outside, on which the articles to be hardened are suspended. The height of the hooks from the surface of the liquid is such as to allow the steeled part only to be immersed. As soon as the hardening is effected, the articles are removed and cooled in cold water. With the best cast-steel a temperature of 510° has been found to produce a good result in hardening in about 45 minutes.—*Scientific American.*

NEW METHOD OF AMALGAMATING ZINC.

The following method of amalgamating zinc was discovered by Professor Stoddard of Ohio, and communicated to the editor of *Silliman's Journal.* It consists in the employment of double chloride of zinc and ammonia (the same solution which is so useful in soldering iron and steel). The zinc to be amalgamated is heated to about 450° or 500° Fahrenheit, and the liquid applied by a cloth or sponge, and the mercury suffered to flow immediately over the surface while still moist. The union is instantaneous and complete, and the depth of the amalgamation is easily regulated by the quantity of mercury suffered to remain in contact with the zinc. This method is applicable even when the zinc is thoroughly oxydised on the surface; but if it has been previously used in a galvanic battery, it is best to cleanse the surface first by immersion in somewhat concentrated hydrochloric acid. A set of Grove's cylinders thus amalgamated, it is stated, has been used at Miami University during a long course of lectures without serious injury and without reamalgamation.

TO ZINC COPPER AND BRASS.

Professor Boettinger, of St. Petersburg, has published a new process for covering plates and wires of copper, brass, &c., with a brilliant coating of zinc. Pour melted zinc into a mortar of heated iron and keep stirring it until it becomes solid. Then place it in a porcelain or other non-metallic capsule, and pour a saturated solution

f sal-ammoniac over it, after which the solution should be boiled. 'he article to be coated should be first dipped in weak chloric acid, nd then put into the boiling sal-ammoniac and zinc, and in a few mintes it will be covered with a brilliant coating of zinc, very difficult to emove by friction. The galvanic action in this case is thus explained. 'he double chloride of zinc and ammonium formed is decomposed y the zinc and the plate of copper. The chlorine disengaged from ie sal-ammoniac goes to the zinc, and the ammonium escapes in gas, 'hile the undecomposed sal-ammoniac, combining with the chloride of inc, forms the double chloride, a very soluble and easily decomposed alt. If, then, an excess of zinc exists in the solution in contact with ie electro-negative copper, the salt is decomposed into its elements, nd the reduced zinc is deposited on the negative copper.

PLATING BY HEAT.

M. Hessenberg, of Leipsic, has recently discovered a new process or plating by heat, and he has read a paper descriptive of it to the 'olytechnic Society of that city. The metal to be plated is first well leansed and polished, and its surface is moistened with salt water by a amel's-hair pencil, after which it is covered with a powder made as folows. Silver is dissolved in nitric acid, and precipitated by the introuction of a slip of copper; the precipitate must then be washed and ried. Next, one part of this precipitate or powder, one part of the hloride of silver, and two parts of calcined borax, are carefully mixed ogether in a porcelain mortar and washed through a fine silk sieve. 'his powder having been placed on the metal in such a manner that a iyer of it covers the whole surface, the metal is put in a clear charoal fire and heated to redness. It is then removed and immersed in oiling water, either pure or having a small quantity of the tartrate of otash in it. After this a stiff brush is rubbed over every part, and it ppears to be already entirely silvered, which is very important, as his is the basis of the art, and the silver in this way penetrates the ietal for the following operations. The metal is now again covered 'ith a paste made of equal portions of silver powder, pure sal-ammoiac, pure salt, sulphate of zinc, and clear ox-gall. All these ingreients are ground together, adding a little distilled water with a small uantity of dissolved gum in it, and then the paste is laid on with a encil, after which the metal is again placed in a clear charcoal fire, eated cherry-red, plunged in boiling water, and well rubbed as soon s it is cool. This process is gone through with four or five times, 'hen the metal is sufficiently silvered, and is therefore fit to receive he burnisher's lustre. Articles plated in this way show when broken hat the silver has evidently penetrated the copper, thereby insuring he durability of the plating. The points or edges of goods from 'hich the silver has been worn off may be re-plated by this means, and t is necessary to apply the process only to those parts which require enewal, a silversmith's forge being used as the furnace.

BRITISH GOLD.

UNDER this title we are not about to describe the really precious metal of this country, or the produce of a home California; but simply an ingenious and interesting discovery in the manipulation of metalliferous substances, by which an alloy is produced that is likely to come into very general use for numerous articles hitherto manufactured in gilt-work, ormolu, and other more expensive metals. It is a mixture in certain proportions of copper, tin, zinc, &c., perfectly homogeneous, close in texture, highly ductile; it rolls into sheets, and is manufactured with the greatest facility. It can be had of various tints, to represent gold of different degrees of color and purity, takes a high degree of polish, and cleans easily when tarnished. We have inspected some small articles, pencil-cases, &c., manufactured from this alloy, and it would indeed be difficult for the most practised eye to discover that they were not gold, without having recourse to the acid-test, or ascertaining the specific gravity, which is of course less than that of the precious metal.—*Mining Journal.*

GERMAN SILVER.

FEW of our readers are probably aware how many applications are now-a-days made of this useful composition. We call it composition, although the majority of the people imagine that it is a metal *sui generis;* but such is not the fact. It is composed of one part of nickel, one part of spelter or zinc, and three parts of copper; but all these substances have to be pure, and must be exposed to a great heat before they mix among themselves. The zinc metal, which is of a volatile nature, is not put in the pot until the first two metals are well united together. The refractory nature of nickel, and the difficulty of obtaining the metal free from arsenic, iron, and cobalt, are the causes that not unfrequently we see German-silver spoons of gold-yellow color, while German silver prepared from pure metals will equal in whiteness sterling silver, and will not tarnish. Upwards of 50,00lbs. of this composition are manufactured in this country annually, for which the nickel is imported from Germany and England. There are but three localities of nickel ore in this country:—an ore from Chatham, in Connecticut, yields about three per cent. nickel; another ore from the mine La Motte, in Missouri, yields about ten per cent. nickel; and lately a nickel ore has been discovered among the copper ore on Lake Superior.

German silver was first introduced into the United States by Dr. Feuchtwanger, of New York, who was obliged to pay on his arrival in this country, the custom-house duties of silver, the inspectors not knowing any difference. He is the first manufacturer of the German silver in the United States, and he is justly entitled to the paternity of this useful composition. He received, in 1834, '35, and '36, silver medals from the American Institute for the crude material, and for his exhibition of over a hundred different useful articles. We regret much that he has not realized that remuneration which his perceptive

powers and ingenuity ought to have awarded him, while other men have realized fortunes, and continue to do so, from the information imparted by the knowledge of Dr. Feuchtwanger. In 1837 the Doctor petitioned Congress to grant him permission to issue $30,000 worth of pennies made of his composition, as an experiment to substitute the German silver for the copper currency, and John Quincy Adams and Mr. Benton spoke in the highest terms of this proposition, and it met the approbation of the President and the members of both Houses. He failed, nevertheless, on account of the unfavorable report of the Directors of the Mint, who stated that the right of coinage belongs to the Government, and that it required some skill to analyze the German silver.—*Hunt's Merchants' Magazine.*

FRAUD IN THE MANUFACTURE OF GOLD PENS.

A RECENT examination of some gold pens in the laboratory of the Lawrence Scientific School, Cambridge, showed that they were composed of galvanized iron, coated with an extremely thin plating of gold. The pen was apparently at first stamped from thin sheet-iron, then coated with zinc, and lastly with gold, the last being put on by galvanic electricity. The combination of zinc and iron to form the body of the pen was most ingenious, and adapted to prevent corrosion, as the pen resisted the action of the strongest acids for some time. The pens were stamped as the "Cobden Pen," and not with the name of any manufacturer.—*Editors.*

SALT IN NEW YORK.

FROM a letter from Mr. Gere, the superintendent of the Syracuse Salt Springs, we learn that the quantity of salt manufactured during the season amounts to about 5,066,000 bushels, being an increase of 330,000 over any previous year. Salt has declined in price the whole season, finally coming as low as 65 cents per barrel, including the duty. The only new shaft sunk is one at Salina, to a depth of 220 feet, being 40 feet more than any other at that place. With the proper deductions, the price received for the salt is but 38 cents for a barrel of five bushels.

BLAKE'S PATENT FIRE-PROOF PAINT.

THIS new fire-proof paint is formed from a peculiar mineral substance found in large quantities in a stratum of rock in Sharron, Ohio. It is composed of silica, alumina, protoxide of iron, and magnesia, with a small admixture of lime and carbon. It has the appearance of the finest indigo; but a few days' exposure turns it to a hard stone. The examining committee of the fair of the American Institute, of 1848, reported that it was an article superior to every thing that had previously been presented, as a fire and weather proof covering, and awarded to Mr. Blake a medal. The fair of the State of New York, held in Buffalo, also awarded a medal. The agents of all the fire-in-

surance companies in Akron, Ohio (where the paint is best known), have issued circulars to the effect that they will insure buildings the roofs of which are well covered with this paint at lower premiums than those covered with tin or zinc, as they consider it a better fire-proof. It forms a complete stone covering, impervious to the action of the weather and of fire, and the longer on, the harder and more permanent it seems to become. The chocolate-color produced with a slight mixture of white lead forms a coating through which not a particle of moisture can penetrate. It never, we are informed, peels off, and cannot fade, as it is the natural color of the substance.—*Hunt's Merchants' Magazine.*

NEW PAINT.

Mr. W. Longmaid, of London, has lately taken out a patent for a new way of treating the oxides of iron and obtaining products from them for making paints. The mode of operation, which certainly has the merit of being novel, is as follows. The oxide of iron is reduced to a powder, and then resin or tar is mixed with it in the proportion of 10 or 15 per cent., the larger quantity being preferable. The resin or tar, if used dry, should be pulverized, but when used in a semi-fluid state, it is mixed directly with the oxide and dried afterwards. The materials, being mixed, are put into retorts of cast-iron, which are about five feet long, and the only opening is closed with a cover. The retorts are then placed vertically in a furnace with the cover downwards to allow the escape of the gaseous matters evolved, and are allowed to remain at a fixed temperature for two hours after the gases have ceased to escape. After this they are suffered to cool gradually, and the product obtained is a dark-colored matter, which when used as a pigment with oil forms a paint. If the escaping gases are preserved, they produce a volatile oil and an inflammable gas.

SUBSTITUTE FOR FRESCOS.

A method of wall-painting has been invented at Berlin by a M. Fuchs, which promises to supersede the difficult *al fresco* process. It is stated to be much more durable and better adapted to the changes of a northern climate than the Italian method. An experiment was made a year ago to test the power of the colors to resist a very destructive agent, the result of which has just been ascertained. In September of last year a portrait on stone was painted according to the new process by Kaulbach, and given for trial to the director of the Royal Museum. It has ever since been deposited in the chimney, exposed to a twelvemonth's smoke, and when recently taken out it was covered by a thick coating of soot that was removed with difficulty, but the painting beneath was found uninjured, with the colors clear and bright.

IVORY AS AN ARTICLE OF MANUFACTURE.

An English gentleman stated some interesting facts concerning ivory in a recent lecture at Sheffield. There are several sorts of ivory, differing from each other in composition, durability, external appearance, and value. The principal sources from which ivory is derived are the western coast of Africa and Hindostan. Camaroo ivory is considered the best, on account of its color and transparency. In some of the best tusks the transparency can be discovered even on the outside. The manufacturers have a process by which they make poor ivory transparent, but it lasts only for a short time. A third kind of ivory called the Egyptian, has lately been introduced, which is considerably lower in price than the Indian, but in working there is much waste. By an analysis, the African ivory shows a proportion of animal to earthy matter of 101 to 100; the Indian, 76 to 100; and the Egyptian, 70 to 100. The value of ivory consumed in Sheffield, where it is much used in making handles for cutlery, is about $140,000, and nearly 500 persons are employed in working it up. To make up the weight of 180 tons consumed in that place, there must be about 45,000 tusks, whose average weight is 9 pounds each, though some weigh from 60 to 100 pounds. According to this the number of elephants killed every year is 22,500; but allowing that some tusks are cast and some animals die, it may be fairly estimated that 18,000 are killed every year merely for the ivory, which is contrary to the usual belief that the ivory used comes from the tusks cast by living elephants. These estimates, it will be seen, are for Sheffield merely.

TO RESTORE DECAYED IVORY.

Mr. Layard, in his explorations among the ruins of Nineveh, discovered some splendid works of art carved in ivory, which he forwarded to England. When they arrived there, it was discovered that the ivory was crumbling to pieces very rapidly. Professor Owen was consulted to know if there was any means of preventing the entire loss of these specimens of ancient art, and he came to the conclusion that the decay was owing to the loss of the albumen in the ivory, and therefore recommended that the articles be boiled in a solution of albumen. The experiment was tried with complete success, and the ivory has been rendered as firm and solid as when it was first entombed.

HOLLOW BRICKS.

Compressed bricks, with a longitudinal perforation, have been brought into use in England, in the construction of edifices. The plan, however, is not of recent origin, having been known to the ancients, and applied in the construction of some of the early Christian churches in Italy. These bricks, being considerably lighter than the solid ones, may be used with advantage and economy in the construction of arches, and the partition-walls of dwelling-houses and other

buildings. They have also the recommendation of combining dryness with facility of ventilation.—*London Athenæum.*

AMERICAN QUEENSWARE.

The manufacture of Queensware, like that of glass, is rapidly advancing in this country. There are at Liverpool, Ohio, seven different establishments, giving active exercise to a large amount of capital, and employing upwards of 180 workmen. They turn out more than $70,000 worth of the ware annually, and the *Pittsburg Gazette* says:—

"The ware which is of two colors, either of a light yellow or of a dark mahogany hue, is as strong and well glazed as any we have ever seen, while the patterns are, in many instances, very chaste and graceful. This branch of our manufactures has sprung up within the past few years, and has already driven the English yellow ware from our market. It is sold in vast quantities in New York, Philadelphia, and the other Eastern cities, as well as in Pittsburg, Cincinnati, Louisville, St. Louis, New Orleans, and the rest of the Western towns."

At Zanesville, Ohio, there are also large factories.

CALCINED GRANITE AS A MATERIAL FOR FICTILE PURPOSES.

Mr. Archibald M'Donald has lately been engaged at the Seyton Pottery, Aberdeen, in making some experiments upon calcined granite as a substitute for clay in the manufacture of pipes and other earthen-ware articles. He states in a note to us, that the material stands a strong fire and is not affected by transitions from heat and cold. The native color of the stone can be nearly retained in the formation of busts, statues, vases, urns, and general pottery, as also in chimney-pieces, spouts, &c. In such articles as are intended to withstand the effects of great heat, where an extract only of stone is used, the color cannot be kept so well, as, for example, in retorts and crucibles; but any preparation of the material, when once properly finished, may be heated to whiteness without injury. The experiments have been carried on under great disadvantages, but have thus far all been satisfactory.—*Practical Mechanic's (Scotch) Journal.*

THE EFFECT OF STEAM UPON TIMBER.

M. Violette has lately presented to the French Academy a very able communication on the desiccation of different kinds of wood by steam. He ascertained that steam raised to 482 degrees Fahrenheit was capable of taking up a considerable quantity of water, and acting upon this knowledge, he submitted different kinds of oak, elm, pine, and walnut, in pieces about 8 inches long and half an inch square, to a current of steam at 7½ pounds' pressure to the square inch, which was afterwards raised to 482 degrees. The wood was thus exposed for two hours. It was weighed before it was exposed to the steam, and afterwards placed in closely stopped bottles until it became cool,

when it was again weighed, and showed a considerable loss of weight, which increased with the increase in the temperature of the steam. For elm and oak the decrease was one half, for ash and walnut two fifths, and for pine one third. The woods also underwent a change of color as the heat was rising from 392 to 482 degrees; the walnut became very dark, exhibiting a kind of tar formed in the wood by the process, which was found to have a preserving effect on the wood. It was ascertained that wood thus treated became stronger, having an increase in the power of resisting fracture. The maximum heat for producing the greatest power of resisting fracture was, for elm from 302 to 347 degrees; for oak, walnut, and pine, from 257 to 302. The oak was increased in strength five ninths, walnut one half, pine two fifths, and elm over one fifth. By this process of steaming, the fibres of the wood are drawn closer together, and maple and pine treated with steam at a temperature of 482 degrees were rendered far more valuable for musical instruments than by any other process heretofore known. These, however, are but preliminary experiments, which it is expected will lead to very important results.

DISSOLVING BONES BY STEAM.

A STATEMENT has lately been made to the Highland Agricultural Society of Scotland in relation to pulverizing bones by steam, and it was asserted that bones of any size could be reduced to a soft mass in the following manner. All the machinery necessary is a small boiler with a steaming-vessel connected with it capable of bearing a pressure of twenty-five or thirty pounds to the square inch. The vessel being filled with bones and subjected to the action of steam above the level of the boiler (as they will not dissolve if covered with water), at twenty-five pounds' pressure, for a few hours, they will become quite dissolved, thus saving all the expense of grinding and the sulphuric acid commonly used, which amounts to double the price of the rough bones. By this new process the bones are so much softened that they can be crushed by the hand. Dr. Anderson, the chemist, thinks the steaming process cheaper than the old one, and Prof. Traill considers it preferable, because all the animal matter, a portion of which is commonly lost, and the gelatine are saved.—*Albany Cultivator*.

CINCINNATI LARD AND OIL MANUFACTURE.

WE learn from the Cincinnati papers that there are upwards of thirty large establishments in that city employed in the manufacture of lard-oil, which is accomplished by divesting the lard of one of its constituent parts,—stearine. The largest of these, whose operations are probably more extensive than any other in the United States, has manufactured heretofore into lard, oil, and stearine 140,000lbs. monthly, all the year round, and the great increase of hogs for the present season will probably enlarge that business this year 50 per cent. It is calculated that 11,000,000lbs. of lard will be run into lard-oil this year, two-sevenths of which aggregate will make stearine, the residue

oil, say about 24,000 barrels of 42 gallons each. Much the larger share of this is of inferior lard, made of mast-fed and still-fed hogs, the material, to a great extent, coming from a distance; hence the poor quality of Western lard-oil. Lard-oil, besides being sold for what it actually is, is also used for adulterating sperm-oil, and in France serves to materially reduce the cost of olive-oil, the skill of the French chemists enabling them to incorporate from 60 to 70 per cent. of lard-oil with that of the olive. There is also an establishment in that city which, besides putting up hams, &c., is extensively engaged in extracting the grease from the rest of the hog, and will probably this year operate in this way on 30,000 hogs. It has seven large circular tanks, six of capacity to hold each 15,000lbs., and one 6,000lbs. These receive the entire carcase, with the exception of the hams, and the mass is subjected to steam-process, under a pressure of 70lbs. to the square inch, the effect of which operation is to reduce the whole to one consistency, and every bone to powder. The fat is drawn off by cocks, and the residuum, a mere earthy substance, is taken away for manure. Besides the hogs which reach this factory in entire carcases, the great mass of heads, ribs, backbones, tail-pieces, feet, and other trimmings of the hogs cut up at the different pork-houses, are subjected to the same process, in order to extract every particle of grease. This concern alone is expected to turn out this season 3,600,000lbs. of lard, five sixths of which is No. 1. Six hundred hogs daily pass through these tanks one day with another.

The stearine expressed from the lard is used to make candles by being subjected to hydraulic pressure, by which three eighths of it is discharged as an impure oleine; this last is employed in the manufacture of soap; 3,000,000lbs. of stearine have been made in one year into candles and soap in these factories, and they can make 6,000lbs. of candles per average day throughout the year.—*Hunt's Merchants' Magazine.*

ELASTIC MOULDS.

THE art of making elastic moulds, for copying statuary, designs, &c., has lately been introduced into the Sheffield (England,) School of Design. It possesses great advantages over the old plan, as the moulds may be made at small cost and with great rapidity. That which would occupy five or six days in the modelling, may be furnished by this process in half that number of hours. By the facility thus afforded, beautiful forms may be multiplied so cheaply as to be brought within the reach of all. The principal material used for the elastic moulds is glue or gelatine. The best fish-glue will answer as well as gelatine, and is much cheaper. The material is dissolved, like glue, in a vessel placed over the fire, in a pot of hot water,—stirring it during the process. To each pound of the gelatine it is necessary to add three quarters of a pint of water, and half an ounce of beeswax. It is ready for use when about the thickness of syrup. The model must be oiled carefully with sweet oil, and the composition must be poured upon it while warm, but not boiling. Having set, it may be taken off the model. When the model is small, it should be placed in

a case, which gives facility for shaking the mould well when the plaster is poured, so as to drive it well into the crevices. The plaster should be fine; and, in order that it may harden and set quickly, about half an ounce of alum should be added to each pint of water used in mixing it. Before using the mould, it should be carefully oiled. Great care is required in mixing the plaster and watching it when in the mould, for if it be allowed to remain long enough to heat, the mould is destroyed.—*Sheffield (England) Independent.*

DISTILLATION OF SALT WATER.

Many machines have been invented for the purpose of distilling fresh water from salt water, but hitherto there has always been some objection to each and all of these contrivances. But the British government seem to have satisfied themselves that a Mr. Grant has invented something which will answer the purpose, for they have lately provided several of their vessels of war with his machine. He calls it "The Distilling and Cooking Galley." By some improvements made since the first invention, the quantity of fresh water obtained by the distillation of salt water during the time it is necessary to keep the galley-fires lighted for the purpose of cooking will, on the average, supply every person on board the vessel with one gallon of distilled water every day. This water is preferred to that usually supplied to ships for drinking and culinary purposes; and, as it passes immediately from the condenser to the water-tanks, it enters the latter at the temperature of the sea. In a few hours the simple motion of the ship, without any chemical means, completely aerates the water, and removes the vapid flavor which characterizes distilled water. Experiments are in progress with a view of imparting at the moment of distillation the oxygen of which the water is deprived in the process, and thus giving to it the briskness of spring water This is proposed to be effected by passing a current of electricity through the particles of water by means of a very simple, self-acting apparatus.—*Abridged from the London Times.*

FENCE FOR FIELDS LIABLE TO BE OVERFLOWED.

This simple invention is patented by Wm. Miller, of Pennsylvania. Two posts should be taken, about 7 inches square, and 5½ feet long, and sunk 3 feet in the ground. A triangular mortise, 2 inches deep, 4 high, and 5 wide, must be cut in the side of the posts 3 or 4 inches from the ground, and a shallow notch in the form of a V must also be cut in the top of the posts, and rails, corresponding in form with this notch, are laid on them. The lower rail is fitted into the mortise by making the ends round, like gudgeons, which are to be inserted in the mortise, each gudgeon being about 2½ inches in diameter, and of any length. The boards being then nailed on the side of the rails against which the water flows, whenever the flood strikes them, the round gudgeons will slide up the sloping sides of the mortise, and the upper rails will rise out of the notches, so that the entire pannel will fall flat upon the ground, being secured by the gudgeons. After the flood has

subsided, it is only necessary to lift up the fallen panels, and the fence will be as firm as when first erected.—*Albany Cultivator.*

WAGONS AND CARTS.

A FARMER in England, named Edward B. Liddington, has produced a prize-essay on the comparative merits of wagons and carts, which should arrest the attention of our farmers; for if he is right, they in general are wrong. After five years' experience with wagons, and nearly the same with one-horse carts, on a farm of one hundred and seventy acres of arable and eighty acres of pasture land, he came to the conclusion that the carts were of the greatest advantage. As our farmers all use wagons, let them pay some attention to his statement. He says,—"I have no light ploughed land, nor have I more than twenty or thirty acres of very heavy land. I will, therefore, relate my actual experience. In the employment of wagons and the old broad-wheeled dung-carts, I required one wagon, one cart, and three horses, to every fifty acres of arable land. I also kept a light cart for general purposes. Now that I am employing carts, I find that I get through my work much more easily with two horses and two carts to fifty acres."

In the calculation of items, his saving was nearly four dollars on the cultivation of one acre, in the year. Again he says, it is admitted that one horse attached to a given weight will move it more easily than two horses attached to double that weight. This arises, not only from the advantage gained by having all the power of draught close to the work, but also all the power applied at the same moment, which is almost impossible where two or more horses, having different wills and steps, are attached to the weights; and for the same reason, one horse will travel more quickly.

When a cart is filled, there is no delay in attaching the trace-horses, during which operation one horse would be two hundred yards on the road. I know this might be done more quickly by having men ready to change the horses, as in the practice of opposition coaches; but I am speaking of the matter-of-fact working of the system. Then, again, when the load is deposited, the one horse turns in much less time than the two or three. These facts are too self-evident to admit of their contradiction; indeed, I believe the economy of carting manure with one-horse carts is generally allowed, but the employment of them in harvesting is much objected to. In this respect, however, I find them equally expeditious and economical. My actual experience is, that three carts, with the harvest frames attached, will convey as much hay or corn in the straw as two wagons, and that they are bound with the ropes in the same time; therefore no time is lost in the binding. They are easier to pitch into than wagons, and not more difficult to unload; and all the advantages are gained of speed in travelling.

My attention was first drawn seriously to the subject, from hiring a man to draw some stones for draining. He came with a horse only fourteen hands high, and a small cart, when the work he accomplished so surprised me, that I at once decided to try two light carts,

which, after succeeding well in all other operations, I employed in the harvest-field, and being fully satisfied with them in this capacity, I soon discarded every wagon from the farm.—*New York Farmer and Mechanic.*

LONDON COAL EXCHANGE.

THE desiccated floor of the London Coal Exchange consists of upwards of 4,000 pieces of wood, of various kinds and qualities. The great feature of the affair is, that the whole of these pieces were, only a few months since, either in the tree in the growing state, or cut from wet logs, and were prepared for use in the course of a few days, by a new method of seasoning. The names of the woods thus introduced are black ebony, black oak, common and red English oak, wainscot, white holly, mahogany, American elm, red and white walnut (French and English), and mulberry. It is mentioned as a proof of the rapidity of this mode of seasoning, that the black oak is part of an old tree which was discovered and removed from the bed of the Tyne River about the latter end of last year. The mulberry-wood, introduced as the blade of the dagger in the city shield, is no less than a piece of a tree which was planted by Peter the Great, when working in this country as a shipwright. The patentees state that no one piece of the 4,000 occupied more than ten or twelve days in seasoning.—*London Builder.*

FIRE-ANNIHILATOR.

A NUMBER of experiments have been made at the London Gas Works, with "Phillips's Fire-Annihilator." These were preceded by an explanation from Mr. Phillips of the manner in which he was led to the discovery, and of the principles upon which its success depends. He stated that, while watching a volcanic eruption in the Mediterranean, he observed that the huge column of water which was discharged from the crater did not extinguish the flame which accompanied it, while the smoke of a brushwood fire swept by the wind put out another brushwood fire near it. He then introduced the "fire-annihilator," which at once extinguished very large fires fed by the most combustible materials. The extraordinary speed, ease, and certainty with which the invention acted, excited the surprise and admiration of many scientific gentlemen who were present, and there can be little doubt that the "fire-annihilator" is a very valuable addition to the discoveries of the age. In construction and application, it has the great advantage of being extremely simple, and it is quite portable, and capable of being placed where it would be most accessible when needed. The gases which it evolves, and which are found so efficacious in extinguishing flames, are produced from a compound of charcoal, nitre, and gypsum, which is ignited by breaking a bottle containing sulphuric acid. The acid drops upon chlorate of potass and sugar, and instantly a large body of vapor is evolved with great force from a tube connected with the metal chamber in which the whole materials are inclosed. This vapour extinguishes the flames with a rapidity which is truly marvellous.—*London Athenæum*, Sept.

VALUABLE DISCOVERY IN THE MANUFACTURE OF INDIA-RUBBER.

A GREAT part of the usefulness of India-rubber depends upon the process known as "vulcanizing," whereby textures of which it forms a part are exempted from the action of heat and cold. This process has hitherto been performed by the mixture of sulphur and lead, or of sulphur alone, with the rubber. A discovery just made in England, by a Mr. Burke, will put an end to the contests between patentees of various processes in this country, by introducing a new process, which is simpler and cheaper than the old ones, and dispensing with the use of sulphur, as it does, avoids the unpleasant smell caused by that substance. Though patented in England, this new process has already been employed in this country, so that it cannot now be monopolized here.

The discovery may be succinctly described as follows. We condense from the language of the inventor.

Mix 15 parts of golden sulphuret of antimony with 100 parts of India-rubber, and when thoroughly "masticated," as known to manufacturers, the articles are to be made up, and then submitted to heat in a boiler under pressure at a temperature varying from 260° to 280° Fahrenheit.

A manufacturer of this city has shown us specimens made by mixing a much larger portion of golden sulphuret of antimony with the same quantity of rubber named above. The product is exceedingly elastic, tough, and beautiful in appearance, while it is perfectly free from the smell of sulphur. At the same time it has no appearance of bloom, which is a point of the first importance.

The heating of compounds of rubber in a boiler under pressure was first introduced from England into the United States some three years ago. Since then, the manufacture of rubber goods has more than doubled in amount. This new discovery, by which antimony takes the place of sulphur, will extend still further this branch of American industry, than which none has received more attention from scientific men.

The same inventor describes a new kind of cloth in these words:—

"The second part of my invention refers to the manufacture of water-proof cloths or garments known as single textures, and consists in removing the shiny or polished appearance of the surface thereof, which is very generally objected to from its resemblance to common oiled or painted cloths. In order to effect this improvement, I mix with caoutchouc, either prepared as above or not, from ten to fifteen per cent. of ground silk, cotton, or wool (after the manner of flock), and dissolve it in a suitable menstruum, or I mix the flock with the caoutchouc when dissolved. With this solution I coat the surface of the cloth, which has previously been prepared with the water-proof composition in the ordinary manner of such manufacture, and thereby impart to the water-proof surface an appearance greatly resembling woollen cloth. This cloth may be afterwards put through the heating process, and another cloth or fabric cemented thereto as a lining, if required."—*New York Tribune.*

NATURAL PHILOSOPHY

THE ELECTRIC LIGHT.

MUCH has been said and written upon the application of the powerful light produced by artificial electricity to the purposes of illumination. Many varieties of apparatus have been invented, to all of which there has hitherto been some great objection. Perhaps the greatest difficulty to be surmounted has been that of rendering the light steady and permanent by mechanical means, so that it shall not require any attendant. This difficulty, at least, seems to have been obviated by the invention we are about to describe.

The light is called "Staite's Patent Electric Light," after its inventor. It is produced from a galvanic battery of moderate size, embracing in its construction and elements several features, which are claimed to be improvements, the object of which is to render the battery constant, continuous, and regular in its action, and economical in its cost. By means of solid copper wires the electric fluid is conveyed to the lamp, which may be placed on a table or suspended from the ceiling. In this lamp are two cylinders of carbon, which are used as electrodes, that is to say, the current of electricity is passed from one to the other as they stand end to end, their ends being separated from one twentieth to one half an inch, according to the power of the current applied; and these cylinders are moved by a clock-work arrangement, in proportion as they are consumed, at a speed which is regulated by the currents. To render the light continuous, it is necessary that these two pieces of carbon should first be brought into actual contact, so that the current may pass and then be separated to a short distance. This is accomplished, and here is the grand feature of the invention, by *the current itself*, without manual aid. As the carbon gradually wears away, at the rate of about an inch in two hours, the same regulated distance between the two electrodes is preserved by like means. The apparatus for effecting this self-regulation is an electro-magnetic instrument, placed directly under the plate of the lamp, through which the current of electricity is caused to pass. The principle of this instrument is very ingenious, in some degree resem-

bling a galvanometer; the galvanic current, passing through a coil of wire, magnetizes a bar of soft iron, which is passed through the coil; and in proportion as the current is strong or feeble, the magnetized bar rises or falls. When the current is in excess, it actuates an escapement, and the two electrodes are drawn to the required distance apart; and when the current passing is less than the regulated quantity, the motion is reversed, and the electrodes are drawn nearer together.

Thus the light is rendered steady and constant, while no more of the fluid is allowed to pass than is developed in light, effecting a great economy of battery-power. To prevent injurious vibrations or sudden movements of the iron bar, it is provided with a rack, wheel-work, and fly. Another improvement consists in giving the upper electrode the form of a circular disk made to revolve slowly in contact with a fixed scraper, which keeps the edges clean and free from the particles of carbon projected upon it from the lower electrode. The carbon is prepared by forming a powder of charcoal into paste with melted brown sugar, pressing it into iron moulds, and baking it in the moulds at a red heat, and afterwards in a crucible at a white heat.

There have been several public exhibitions of this light, all of which have been successful. In one case it was exhibited in the large rooms in Hanover Square, London. The rooms were, as usual, lighted with chandeliers of wax candles, with a considerable number of oil-lamps; the total amount of light being considered to be equal to 200 or 300 wax candles. On the lecture-table was the light apparatus, covered with a tall glass shade. All things being made ready, the galvanic circuit was completed, and in a few seconds the whole apartment was filled with such a blaze of diffusive light, as caused the now dimly burning candles and lamps to assume the muddy and lack-lustre aspect they bear in ordinary sunlight. Every object in this large room was brilliantly illuminated, and as an assistant turned the light on and off at pleasure, the transition was as violent as from broad day to evening twilight. The paintings on the ceiling were finely displayed; and, what was very remarkable, the tone of the colors was precisely similar to that which they are seen to possess in daylight. All the delicate intershadings of the yellows, grays, flesh-tints, and even of greens and blues, were brilliantly defined, and in all respects conveyed the daylight impression to the eye. The light was about equal to that of 700 or 800 standard wax candles, yet a lady's bonnet might have covered the entire apparatus; and the actual source of light did not occupy an area of more than an inch in every direction, if so much. The rays were then concentrated by a powerful lens, and directed upon some pictures, which were placed for the purpose on the side of the room, and the colors could be as clearly seen as by the light of the sun.

By means of a glass prism, a spectacle yet more beautiful was shown: this was the display of the *prismatic spectrum*, the entire number of the rays being present, and in brilliancy not to be distinguished from the same as shown by the decomposition of the true

solar light. Perhaps one of the most striking displays of the character of the electric light followed. The electrodes were immersed in a globe of water, and still the light continued gleaming forth in all its brilliancy. Those who are familiar with the oxyhydrogen light, and the peculiarly white and somewhat intense light of the camphine lamp, might have felt doubtful of the result of a contrast with these; but the electric effulgence outshone both to a remarkable degree. It was stated at the time, that a volume of light equal to that of 10,000 wax candles could be evolved by the apparatus from a square inch of actual illuminating surface. It was said that a light of from one candle to 100,000 might be obtained, and sustained, by this new system; and with regard to the cost of production, the light equal to 100 wax candles was obtainable at the rate of a penny an hour, or about, as it is stated by the inventor, one twelfth part of the cost of gas for the same period, and producing the same degree of illumination.

The character of the electric light presents several remarkably interesting features, most of which belong to no other artificial light whatever, and assimilate it to that of the sun itself. The heat evolved is vastly disproportionate to the light produced, as may be conceived from the fact, that the lamp, when pouring forth a volume of light equal to 800 candles, did not emit more heat than that of one Argand lamp equal to six or seven candles. The light has been displayed, not only in air and under water, but also in alcohol, ether, sulphuret of carbon, and in atmospheres of carbonic acid, nitrogen, and hydrogen. The apparatus constructed for domestic use gives a light equal to from eight to forty candles.

There is another point which appears to be important in considering the applicability of this beautiful light to the illumination of streets or great areas, and that is its *diffusibility*. The ordinary modes of illumination are incapable of giving luminosity to the solid and aqueous particles in the atmosphere for any considerable extent, but the electric light effects this admirably, for even if a person places himself in the shadow under a wall, he can easily see to read; so that the argument brought up by some, that, in attempting to light large spaces with a single light, much of the area must be thrown into the shade, is of no weight.

But there is one chemical peculiarity about this light which demands a brief notice. It is found to possess those chemical powers of decomposition, which have been regarded as peculiar properties of the solar light, and which are known under the name of *actinism*. Preparations of silver, which turn black when exposed to the sun's light, blacken also before the electric light; and the chemical union of mixed gases, hydrogen and chlorine, has been effected by placing a jar containing them in the light of the electric lamp.

APPARATUS TO PRESERVE THE ELECTRIC LIGHT CONSTANT.

At the sitting of the Paris Academy of Sciences on the 15th of January, M. L. Foucault reminded the Academy that five years ago

he had exhibited an apparatus, in which the electric light was used to obtain upon a screen a magnified image comparable with that given by the solar microscope itself. But in this instrument there was a great inconvenience arising from the necessity of continually watching and adjusting the charcoal points. This apparatus he has since modified so as not only to keep the poles at the same distance apart by a spontaneous action, but also to keep the radiant point immovable. These results he obtains by the following arrangements. The two points are pressed together by springs, but cannot move in that direction without setting in motion a train of wheels, the last of which is controlled by an escapement. The current of the apparatus passes around an electro-magnet, the energy of which of course depends upon the intensity of the current; this electro-magnet acts upon a piece of soft iron, which is pressed in the opposite direction by a spring. Upon this soft iron is mounted the detent which checks the train of wheels before mentioned, and the direction of the movement is such, that, when the current becomes stronger, it presses upon the wheel-work, and when it becomes weaker, releases it. And, as the current becomes stronger or weaker according as the poles approximate to or recede from each other, it will be seen that the poles become free to approach each other as soon as their distance apart increases, but that they can never come in contact, because the increasing strength of the magnetism developed by their approach presents an insurmountable obstacle, which removes itself as soon as the interpolar distance has again increased. The approach of the charcoal points is therefore intermittent, but the periods of rest and movement succeed each other so rapidly as to be equivalent to a continuous progression.

M. Foucault requested the appointment of a committee to investigate the originality of his invention, as it happens to be very similar to that invented by Mr. Staite. The committee was appointed, and reported "that the means invented by M. Foucault originated with him, and were independent of those invented by Mr. Staite for the same purpose." At a later meeting it appeared that M. Gaigneau, on the 14th of January, 1848, had taken out a patent in London, in the name of Mr. W. Petrie, for an apparatus which fulfilled the same conditions in the same manner; but there was also in the same patent a method of producing an intermittent light for light-houses, in which the period of intermittence could be regulated beforehand.

It would thus appear that, within a few months of each other, Messrs. Foucault, Staite, and Petrie, each without the knowledge of the others, contrived methods for producing a constant electric light, which were almost exactly similar.

EXPERIMENTS WITH THE LIGHT OF THE VOLTAIC ARC.

After giving the description of his apparatus mentioned above, M. Foucault continued:—"We thus obtain by means of my instrument arcs of all kinds, which are persistent, and which can by the aid of lenses be thrown upon a screen, so that their physical appearance can be contemplated, or upon a linear diagram, so that they can

be analyzed by the prism. A commutator is also used to invert the direction of the current, for the purpose of better exhibiting that part of the action due to the positive and negative poles. This study, the end of which cannot yet be seen, has already given me the following results.

"The arc from charcoal points furnishes by the prismatic analysis the most curious and brilliant appearance. Its spectrum is crossed along its whole extent by a multitude of irregularly-grouped luminous lines; but among these a double line is remarked situated on the boundary between the yellow and the orange. As this double ray recalled by its form and position the line D of the solar spectrum, I was desirous of examining whether it corresponded to it, and for want of instruments to measure the angles I had recourse to a peculiar process. I projected upon the arc itself an image of the sun formed by a converging lens, which permitted me to observe at once the solar and the electric spectra superposed, and in this way I ascertained that the double bright line of the arc coïncides exactly with the double black line of the solar light. This process of investigation furnished me with the means of several unexpected observations. In the first place, it proved to me the extreme transparence of the arc, which but faintly shadowed the light of the sun. It showed me that this arc placed in the path of a beam of solar light absorbed the ray D, so that this line of the solar spectrum is considerably strengthened when the two spectra are laid exactly over each other. When, however, they overlap, the line D appears blacker than usual in the solar light, and comes out more brilliant in the electric spectrum, so that we can easily judge of their perfect coincidence. Thus the arc offers to us a medium, which itself emits the rays D, but at the same time absorbs them when they come from another source. To make the experiment still more decisive, I threw upon the arc the reflected image of one of the incandescent points of charcoal, which, like all bodies in ignition, gives no lines, and under these circumstances the line D appeared as in the solar light. Passing, then, to the examination of the arcs furnished by other matters, I have almost always found the line D positive and at its place, and I have ascertained that it coincides exactly with the brilliant line from the flame of a candle When the poles employed are of metals which give the ray D but feebly, such as iron and copper, it can always be revived with extraordinary intensity by touching them with potassa, soda, or by one o the salts formed by lime, or by one of these bases. Before concluding any thing from the almost constant presence of the line D, it will without doubt be necessary to ascertain whether its appearance does not indicate the existence of the same substance mixed with all arc-conductors. Nevertheless, this phenomenon already appears to us a pressing invitation to the study of the spectra of the stars, for if this same line should be discovered, stellar astronomy will be able to make the discovery available.

"I also endeavoured to make these different arcs coincide, and I was again astonished by the appearance of unexpected phenomena. During the coincidences of these various spectra I saw the electric

lines stand out upon the comparatively uniform ground of the solar spectrum, so that it might be seen that, notwithstanding their apparently accidental grouping, they all possessed the tint of color corresponding to their refrangibility. But what is peculiar in this experiment is, that among these electric lines some possess an intensity enormously superior to that of the corresponding solar ray. Especially in the arc from silver there is a green ray, so to speak, inextensible by the prisms, and of a dazzling color. It is a true source of simple light, and as it is insulated, and as the arc from silver is transparent, tranquil, and durable, there is nothing to prevent this ray from being made the source of a green light as intense as may be wanted, and from being utilized for the demonstration of phenomena heretofore indicated by theory alone. Other very intense rays have also their fixed places in different parts of these spectra and even at their extremities, and there is great probability of discovering isolated lines, the rays corresponding to which cannot be seen in the solar light."—*L'Institut, Feb.* 7.

POLARIZATION OF GALVANIC LIGHT.

Professor C. G. Page, of the Patent-Office, has communicated to *Silliman's Journal, No.* 21, a paper on this subject. "Having seen it stated, upon the authority of Arago, that the light of the galvanic arc, like that from incandescent gas, was not polarizable, I have been induced to repeat the experiment, with a view of testing, for my own satisfaction, a principle so important in a theoretical point of view. The experiment was briefly performed, and only with reference to the simple fact itself. The battery employed was a Grove's, of fifty pairs platinum plates, four inches square, and double surface of zinc. By means of a Nicols prism, and one reflection from a plate of mica, the light from the arc between the charcoal points was distinctly polarized. Its property in this respect was much more decided when the arc was first formed than when it had continued for a few seconds. It may be observed, that when the electrodes are first withdrawn the arc is very intense, and does not rise in the arched form immediately, but as soon as the charcoal points have become intensely heated, the arc becomes elongated and rises, from the upward current of air, and the upper portion of the arc is then feeble in intensity. This upper portion did not appear at all polarizable upon a single reflection, but upon two reflections was decidedly so."

VOLTAIC IGNITION.

The following is an abstract of a paper recently read before the Royal Institution (England), on "Voltaic Ignition," by Mr. Grove, well known for his researches on electricity and galvanism. Mr. Grove introduced the subject by asserting that the only true philosophical idea of heat was that which regards it as a repulsive power, —that with the single exception of water, and other bodies which assume a crystalline form when about to freeze (a condition which he

ascribed to a polar state which these substances then take), all matter expands by heat. This expansion of matter, so caused, can be communicated to neighboring bodies. In the case of heat produced by intense chemical action, he ascribed the effect to the physical force of a species of molecular friction on the particles acted on. This chemical force is capable of transfer by the voltaic battery, and the calorific force moves with it. It has been proved, by experiment on a compound wire of silver and platinum, that, in proportion to the increase of conducting power, ignition is diminished. Mr. Grove here referred to recent researches of his own, to prove that this calorific force was affected by external causes. The same current was sent through two coils of fine platinum wire, one of which was surrounded by an atmosphere of air, the other by an atmosphere of hydrogen, when it was found that the wire in air became white-hot, while that in hydrogen was not heated. This phenomenon he ascribed either to the mobility of the particles of the hydrogen, or to the vibrations moving away from the vibrating surface, or to the state of the surface itself, hydrogen being, as to radiating power, to air, as the color black is to white. That this cooling does not depend on rarefaction, is proved by the intense heat and light produced *in vacuo*. Mr. Grove then called the attention of the Institution to a remarkable experiment lately performed by him, with a battery of 500 cells; of the two platinum poles, the positive was placed under water, the negative held over it, when a cone of flame issued from the surface of the water towards the negative pole, on the extremity of which a small globule was formed, which fell off as soon as the current was suspended. These facts may serve to explain more clearly the phenomena of the voltaic arc. Mr. Grove exhibited paper on which the strong disruptive effect of the electric battery had dispersed metallic wires, and he showed that these explosions had always occurred in a line transverse to that of the current. He inferred that when ignition commenced in the wire, its molecules assumed a transverse polar direction. When platinum is ignited under circumstances which admit of the effects being accurately noticed, it contracts, swells, and breaks, and a lead wire, similarly acted on, becomes divided by a series of transverse facets. In conclusion, Mr. Grove adverted to recent endeavors to obtain voltaic light for practical purposes. He stated that recent calculations led him to believe that for some purposes, such as the illumination of light-houses, especially where an intermittent light was wanted, and of the interior of large buildings, it might possibly be adopted at no very remote period. The light of 1,440 candles might be obtained at about four shillings per hour; but this concentrated light is not applicable for streets. The whole subject, however, is beset by many mechanical difficulties.—*London Athenæum, March.*

THE VELOCITY OF ELECTRICAL WAVES.

It is well known that for the past two or three years the electric telegraph has been employed for the purpose of ascertaining the longitude of various places in this country, which has thus been done

much more accurately than it could be by any other method. But in determining the longitude, it becomes a matter of importance to ascertain whether the current does really pass over the wires in a time immeasurably small, as has been commonly stated. The longitude, it is well known, is determined by the difference in the time of the transit of any star at the two places, and as soon as it is observed at one place, the observer, by touching a key, records the fact at the other, by means of an astronomical clock; but if any measurable time is consumed in the passage of the current which causes this record, it must be taken into the account. This subject first attracted the attention of Mr. Walker, of Washington, while ascertaining the longitudes of Cambridge and Philadelphia, and he then became convinced that the time required by the galvanic stream is by no means immeasurably small, but can be determined, and amounts, between Cambridge and Philadelphia, to nearly one twentieth of a second,—being, therefore, very much greater than would have been expected *from analogy*, after Wheatstone's measurement of the velocity of propagation for friction-electricity. Mr. Walker deduces this value from all the comparisons which were made between the three stations, Cambridge, Philadelphia, and New York, and thus finds from 18 equations of condition, that the galvanic current would traverse 18,700 miles in a second. This value is determined to within about 1,000 miles, or $\frac{1}{18}$.

This beautiful result is, in its scientific relations, the more interesting from the fact that the galvanic current here traverses different mediums,—the conducting wire (iron), three batteries, and the earth, a total length of 1,050 miles. It is particularly striking that the velocity of the galvanic current is so much less than that of friction-electricity, according to Wheatstone's observations.

Having formed this opinion, Mr. Walker, of course, felt anxious to verify it, and for this purpose has been engaged in some experiments between Washington and Cincinnati, which are described by Professor Mitchell, in a recent letter. He says,—"The principle employed is very simple, and may be easily understood by those not familiar with the subject. Suppose it possible to start two clocks to beating at the same absolute moment of time in Washington and Cincinnati, and that these beats are both recorded at each station. The Cincinnati clock-beat recorded in Cincinnati by a current of electricity having no distance to go is done instantly, while the Washington clock-beat, being recorded by a current coming from Washington (in case this current should require, say, one tenth of a second of time to pass from Washington to Cincinnati), will fall behind the Cincinnati clock-beat, on the record, by that time, or by one tenth of a second. The reverse is true on the record in Washington. There it is manifest that the Washington clock-beat precedes the Cincinnati clock-beat, in case there be wave-time, and a comparison of the two records (in case no modifying circumstances come in) would show the wave-time, should any exist."

In a recent article in the *Astronomical Journal*, Professor Mitchell gives a detailed account of some of his experiments with reference to

this question, and shows that "the velocity deduced along the wires, in case the circuit is 607 miles long, is 28,524 miles per second." He adds,—"I place great confidence in these results, as every care was taken to eliminate all possible sources of error."

THE PROPAGATION OF ELECTRICITY IN GASEOUS BODIES.

In a paper read before the French Academy, at its sitting on April 16th, M. Matteucci, after noticing some of his former experiments, says,—"Since my first experiments, I have found that the law given by Coulomb, for the loss of electricity in moist air, does not hold entirely true for dry gases, and that in experimenting on these, the results cannot be compared together, unless the experiments are made at the same or nearly the same, temperature. It is known that Coulomb found that the loss of electricity in the same conditions of the atmosphere is proportionate to its intensity, so that the relation between them is constant. The difference between my results and those of Coulomb is, that the number which represents the relation between the electric force lost in a minute and the mean force, is much smaller than that given by Coulomb, and that it varies with the distance at which the electric balls are kept; and for each experiment made at a given distance between them, the fraction which gives the relation mentioned above increases as the electric charge diminishes. So that in air, in hydrogen gas, or in carbonic acid, when dry, the loss of electricity is not proportioned to its intensity, as Coulomb asserted." He concludes by saying,—"We must admit that the gaseous molecules are attracted by the electrified bodies, and remain attached to these bodies, attracting other gaseous molecules around them, so as to propagate electricity as in solid bodies."

THE CONDUCTING POWER OF LIQUIDS WITH REFERENCE TO ELECTRICITY.

The conducting power of liquids varies with the temperature, but in a proportion inverse to that in metallic wires, that is, it increases with the rise of temperature. The fact has long been known, but hitherto measurements were wanting. Edmund Becquerel concludes from his experiments on this subject, which, however, are not very numerous, that the increase of the conducting power proceeds proportionally to that of the temperature. This assumption must, however, be regarded as a rude approximation to the truth. From a more detailed, though still unfinished investigation of Hankel, we learn that the conduction-resistance of liquids is very sensibly diminished by warming, but that this diminution is not proportional to the change of temperature, but is greater for a given difference of temperature the nearer this approaches to zero. The various liquids appear to correspond tolerably in these variations, and only differ from one another in this, that those solutions which contain a larger quantity of salts suffer greater variation in their conducting power for the same differences of temperature. It is singular, that the conductivity of a concentrated

solution of sulphate of zinc, as well as of concentrated sulphuric acid, is increased by a moderate addition of water, but again reduced by greater dilution.—*Liebig's Annual Report.*

The researches of Professor Horsford, on the conducting power of liquids, made contemporaneously with those of Becquerel, and published some years since, have furnished many important facts on this interesting subject.—*Editors.*

CONDUCTING POWER OF FLAME.

It has been long known that flame possesses a property subversive of electricity, but with respect to the cause of this behaviour, the labors of distinguished investigators, for upwards of one hundred years, have only established thus much,—that flame possesses a very strong conducting power for electricity, which can neither be explained merely by the rise of temperature of the air, nor by any conducting property of the aqueous vapor, contained in the hot air of the flame, nor by a current of air, or a removal of electricity by the volatile particles that rise from the flame; for not one of these influences, by itself, evinces the conducting power in so high a degree as flame. However, Volta made use of the flame of a lamp to draw electricity from the air and collect it in his condenser. A few years since, Riess observed that the action of flame extends over much greater distances than does the upward current of hot air, or than this could make the air conductive; and that this current does not move at all. From this he concluded that the flame acts not only by direct communication, but also by induction (influence), and hence he endeavoured to reduce the effect of flame to that of points. He started from the consideration, that the current of hot gas ascending from the flame, and conducting the electricity, was repeatedly cut into and divided by the cold air, (which does not conduct electricity) streaming upon and penetrating it, so that there are formed points and threads, as it were, of the conducting gas, which become more and more attenuated, and are gradually dispersed through the air, under the influence of the colder surrounding medium. These serrations and points now exert their powerful influence in inducing electricity in all directions, and to considerable distances, producing by these means the effects of good conductors. The action of points is also exhibited by substances that do not burn with flame, but merely smoulder, as tinder, slow-match, &c. Riess, however, proves that in this case, when they cannot be caused by the ascent of incandescent gases, they originate in the combustion of the surface of the body itself. These views involved Riess in a long scientific dispute, in which he has increased the probability of his explanation.—*Liebig's Annual Report.*

USE OF GUTTA-PERCHA IN ELECTRICAL INSULATION.

Dr. Faraday, in a letter to Mr. R. Phillips, one of the editors of the *Philosophical Magazine*, states that he has lately found gutta-

percha very useful in electrical experiments. Its use depends upon the high insulating power which it possesses under ordinary conditions, and the manner in which it keeps this power in states of the atmosphere which make the surface of glass a good conductor. All gutta-percha is not, however, equally good, as it comes from the manufacturer's hands; but it does not seem difficult to bring it into the best state. A good piece of gutta-percha will insulate as well as an equal piece of shell-lac, whether it be in the form of a sheet, or rod, or filament; but being tough and flexible when cold, as well as soft when hot, it will serve better than shell-lac in many cases where the brittleness of the latter is an inconvenience. Thus it makes very good handles for carriers of electricity in experiments on induction, not being liable to fracture; in the form of a thin band, or string, it makes an excellent insulating suspender; a piece of it in sheet makes a most convenient insulating basis for any thing placed on it. It forms excellent insulating plugs for the stems of gold-leaf electrometers when they pass through sheltering tubes, and larger plugs supply good insulating feet for extemporary electrical arrangements. Cylinders of it, half an inch or more in diameter, have great stiffness, and form excellent insulating pillars. In these, and in many other ways, its power as an insulator may be useful.

Because of its good insulation, it is also an excellent substance for the excitement of negative electricity. It is hardly possible to take one of the soles sold by the shoemaker out of paper, or into the hand, without exciting it to such a degree as to open the leaves of an electrometer, one or more inches; or if it be unelectrified, the slightest passage over the hand or face, the clothes, or almost any other substance, gives it an electric state. Some of the gutta-percha is sold in very thin sheets, resembling in general appearance oiled silk; and if a strip of this be drawn through the fingers, it is so electric as to adhere to the hand or attract pieces of paper. The appearance is such as to suggest the making a thicker sheet of the substance into a plate electrical machine, for the production of negative electricity.

Then, as to inductive action through the substance, a sheet of it is soon converted into an excellent electrophorus; or it may be coated and used in place of a Leyden jar; or in many of the other forms of apparatus dependent on inductive action.

With respect to that gutta-percha which is not in good electrical condition (and which has constituted about one-half of that which, being obtained at the shops, has passed through Dr. Faraday's hands), it has either discharged an electrometer, as a piece of wood or paper would do, or it has made it collapse greatly by touching, yet has on its removal been followed by a full opening of the leaves again. The latter effect Dr. Faraday has traced and referred to a conducting portion within the mass, covered by a thin external non-conducting coat. When a piece which insulates well is cut, the surface exposed has a resinous lustre, and a compact character that is very distinctive; whilst that which conducts has not the same degree of lustre, appears less translucent, and has more the aspect of a turbid solution solidified. Both moist steam-heat and water-baths are believed to be used in its

preparation for commerce, and the difference of specimens depends probably upon the manner in which these are applied, and followed by the after-process of rolling between hot cylinders. However if a portion of that which conducts be warmed in a current of warm air, as over the glass of a low gas-flame, and be stretched, doubled up, and kneaded for some time between the fingers, as if with the intention of dissipating the moisture within, it becomes as good an insulator as the best.

Dr. Faraday soaked a good piece in water for an hour, and on taking it out, wiping it, and exposing it to the air for a minute or two, found it insulated as well as ever. Another piece was soaked for four days, and then wiped and tried: at first it was found lowered in insulating power, but after twelve hours' exposure to the air, under common circumstances, it was as good as ever. A week's exposure in a warm-air cupboard of a piece that did not insulate, made it much better. A film on the outside became non-conducting; but if two fresh surfaces were exposed by cutting, and these were brought into contact with the electrometer and the finger, the inside portion was still found to conduct.

If the gutta-percha, in either the good or the bad condition (as to electrical service), be submitted to a gradually increasing temperature, at about 350 or 380°, it gives off a considerable portion of water; being then cooled, the substance which remains has the general properties of gutta-percha, and insulates well. The original gum is probably complicated, being a mixture of several things; and whether the water has existed in the substance as a hydrate, or is the result of a deeper change of one part or another of the gum, Dr. Faraday is not prepared to say.

ELECTRICITY OF THE HUMAN FRAME.

At a meeting of the Paris Academy of Sciences. May 21st, M. de Humboldt sent an extract of a letter, in which M. Emilé du Boys-Reymond describes summarily an experiment, which consists in causing the deviation of the needle of a galvanometer by the effect of muscular action. He takes a very sensitive galvanometer, and fixes at its extremities two slips of perfectly homogeneous platina these two slips he plunges into two vessels filled with salt water, and introduces into them two corresponding fingers of his two hands. At the first immersion of the fingers a more or less decided deviation of the needle is always produced, the direction of which follows no law, and which is probably due, at least in part, to some heterogeneousness of the skin of the fingers. When there is a wound on one of the fingers the deviation is stronger, and is always directed in such a way as to show that the wounded finger behaves as the zinc of a zinc-copper couple, supposed to be between the vessels, in place of the body. Of course this is not the kind of action we are concerned with now; on the contrary, in order to observe the effects announced, we must wait either until the needle has returned to the zero of the scale, or until it has taken a steady position under the con-

trol of the remainder of a current, that cannot be overcome. When this moment has come, he strains all the muscles of one arm, so as to establish an equilibrium between the flexors and extensors of all the joints of the arm. At once the needle moves, and the direction of the movement is such as to indicate in the stiffened arm, an inverse current, according to the notation of Nobili; that is, a current directed from the hand to the shoulder. When the experiment is made with the galvanometer by M. Reymond himself, the deflection amounts to 30°. He obtains, however, movements in the needle of far greater extent by contracting alternately the muscles, first of one arm and then of the other, in time with the oscillations of the needle. On bracing simultaneously the muscles of both arms, very small deviations are observable, sometimes in one direction, and sometimes in another; and these minute deflections are evidently caused by the difference between the contractile force of the two limbs. Hence it arises, that when the experiment is repeated many times successively, the results diminish gradually in amount. The amount of deviation depends upon the amount of the development and the exercise of the muscles. The habitual superiority of the right hand over the left, in this experiment, is to be interpreted by the preponderance of the amount of deflection produced by the tension of the right arm. M. de Humboldt says,—"The fact of the experiment affecting a magnetic needle by the alternate tension of the muscles of the two arms, —an effect due to volition,—is established beyond the shadow of a doubt. Notwithstanding my advanced years and the little strength that I have in my arms, the deflections of the needle were very considerable." To facilitate the experiment, it is advisable to plunge the forefingers into the water, and to support the palms of the hands, to enable one to brace up well the muscles of the arm, which it is purposed to bring into play.

Since the announcement of these experiments, many persons have tried similar ones, and only in a single case—that of M. Becquerel —have we seen any failure noticed.

ANIMAL ELECTRICITY.

Mr. Alfred Smee, an English surgeon, and the inventor of the battery which bears his name, announces some important discoveries in animal electricity. By a test which he calls electro-voltaic, he has discovered that the terminations of the sensor nerves are positive poles of a voltaic circuit, while the muscular substance is the negative pole. The sensor nerves are the telegraphs which carry the sensation to the brain, and the motor nerves carry back the volition to the muscles. The brain he infers to consist of five distinct voltaic circles, which, upon theoretical grounds, he believes to be sufficient to account for all the mental phenomena. He has succeeded in making artificial electric fish, and artificial muscular substance. Should these researches be fully confirmed by other investigators, they must be regarded as affording the most important physiological discovery of the age.

FURTHER RESEARCHES ON ELECTRO-PHYSIOLOGY.

We translate from the *Comptes Rendus* the substance of a paper by M. Matteucci, on electro-physiology. He commences by recapitulating the four principal points from which he started, and which, in some degree, form a summary of his former labors. "1. In each cell of the electric organ of fishes, the two electricities become separated under the influence of the nervous activity propagated from the brain towards the extremities of the nerves. A relation exists between the direction and the intensity of the nervous current, and the position and the quantity of the two electricities developed in the cell. 2. It has been shown by experiment that the greatest analogy exists between the discharge of electric fishes and muscular contraction. There is no circumstance which modifies one of these phenomena, that does not equally act upon the other. 3. The contraction of a muscle develops in a nerve which is in contact with it the cause by which the nerve excites contractions in the nerves throughout which it ramifies. Analogy leads us to consider this phenomenon a proof of an electric discharge developed by muscular contraction, though this has not been decided by experiment. 4. The electric current modifies the excitability of the nerve according to its direction: when propagated in the direction of the ramification of the nerve, it destroys its excitability; but when propagated in a contrary direction, it augments it. I shall now confine myself to communicating a result which I regard as fundamental to the theory of electro-physiological phenomena. By a simple experiment, I have shown that an electric current which traverses a muscular mass in the direction of its fibres, develops in these filaments a nervous current, which direction varies according to that of an electric current, relatively to the ramification of the nerve. This is the reaction of electricity upon the nervous force. In discovering a new and very intimate analogy between the electric discharges of fishes and muscular contraction, I have shown that the nervous current develops the two electricities in a determinate direction, according to its own direction. In a muscular mass, the two electric states, diffused through the elements of its fibres, produce a current, whose direction varying with that of the electric current is established, like the direction of the discharge in the torpedo fish, by that of the nervous current which excites it. This foundation of the electro-physiological phenomena I have taken great pains to establish. Whatever may be the nature of the nervous force, it is a fact that this force is propagated in the nerves, sometimes from the brain to the extremities, and sometimes in a contrary direction. It is probable, that when the muscles are contracted by our will, a nervous current is propagated in the direction of the ramification of the nerve; but on the other hand, the nervous current follows an opposite direction when sensation is experienced by the stimulation of the extremities of the nerve.

"I have shown n my former researches, by experiments, the great difference between the nervous and the muscular substance, as regards the conduction of the electric current. These experiments I

cannot repeat, but will confine myself to one, which may be applied to the case in point. This experiment consists in introducing the nerve of a sensitive galvanoscopic frog into the interior of a muscular mass, cut in the direction of its fibres. On passing a tolerably strong electric current through this mass, contractions are never excited in the prepared frog. It is then proved that, when a muscular mass is traversed by an electric current, the nervous filaments diffused through the mass do not produce any sensible part of this current, so that the effects obtained can be due only to the direct action of the electric current upon the muscular fibre, and to the indirect action or the *influence* of the electric current upon the nervous force. The following are these effects. If, in a living rabbit, dog, or frog, we expose the muscles of the legs, and pass an electric current from a pile of thirty or forty elements through the muscles, applying one of the poles to the upper and the other to the lower part of the leg,—if the positive pole is placed above and the negative one below, so that the electric current traverses the muscular substance in the direction of the ramification of the nerves, a very powerful contraction is produced, not only in the muscles of the leg, but also in those of the foot.

"These results can be explained in but one way. The very powerful contraction excited by the electric current proves the existence of a nervous current passing from the extremities towards the centre, and developed under the influence of an electric current which traverses the muscular mass in the contrary direction to that of the ramification of the nerve. These conclusions have an important connection with the law of electric discharges in fishes, which arise from the production of a nervous current by the stimulation of the nerve, which is distributed in the organ. But in the experiments described, a nervous current is produced by the electric discharge passing through the muscle. In the *discharge of the torpedo, therefore, the electric states are produced by the animal, while in the experiment the nervous current is produced by the influence of the electric current.*"

CURIOUS ELECTRICAL PHENOMENON.

We learn from a letter from a gentleman connected with the Bay-State Mills, at Lawrence, Mass., some facts with reference to a new and curious application of electricity which has been introduced into those mills. The electricity is generated by the motion of the machinery, and is employed for lighting up the gas-burners. It exists in large quantities in the card-rooms, where there are many belts running on iron pulleys, and, in the cold dry atmosphere of winter, often produces serious damage to the quality of the carding. The manner in which it was discovered that this electricity could be applied to "lighting up," is somewhat curious. When the gas was first let into the pipes in the mills, one of the overseers discovered fire jetting out from one of the pipes near a belt, and on examination it was ascertained that a small stream of gas was escaping. It was surmised that it had been ignited by the electricity, and to prove it, an experi-

ment was tried. Near a large belt in the carding-room was a gas-burner, and on a bench between them there was placed a small quantity of wool, which is a non-conductor of electricity. If a person stood upon this wool, reaching one hand within two or three inches of the belt, and touching the gas-burner with one finger of the other, the escaping gas was at once ignited with an explosion like that of a percussion cap,—the body of the operator thus being made the medium for conducting the electricity.

The writer adds,—"We shall be able to make a great saving of expense in the woollen manufacture as soon as we can discover an effective method of conducting the electricity away from the cards, as we shall then be able to dispense entirely with the use of oil on the wool, which will save at least $30,000 per annum, when the mills are in full operation."—*Editors.*

ON THE PRODUCTION OF LIGHTNING BY RAIN.

WE find, in *Brewster's Magazine* for Sept., a paper communicated by W. R. Birt, on the production of lightning by rain. The author's attention was attracted to this subject by a question put in the report of the Committee on Physics of the Royal Society, who say,—"There is one point to which we wish that some attention might be paid; it is the sudden gush of rain which is almost sure to succeed a violent detonation immediately overhead. Is this rain a *cause* or *consequence* of the electric discharge? We are not aware that the former view has ever been maintained or even suggested. Yet it is very defensible. In the sudden agglomeration of many minute and feebly electrified globules into one rain-drop, the quantity of the electricity is increased in a greater proportion than the surface over which (according to the laws of electric distribution) it is spread. Its tension, therefore, is increased, and may attain the point when it is capable of separating from the *drop* to seek the surface of the *cloud*, or of the newly formed descending body of rain, which, under such circumstances, and with respect to electricity of such a tension, may be regarded as a conducting medium. Arrived at this surface, the tension, for the same reason, becomes enormous, and a flash escapes." As we have said, Mr. Birt was induced by this paragraph to commence some observations on the fall of rain during thunderstorms, and his first opportunity was on July 25th, when, during a thunderstorm, a sudden gush of heavy rain occurred, which, within two seconds, was *succeeded* by a vivid flash of lightning, and the thunder of course followed this. On the 26th, he had several opportunities of noticing, as there were a number of showers during the day, and on every occasion he is quite certain that the sudden gush of rain *preceded* the electric discharge. The storm of the 26th was a very severe one, and several houses were struck in the immediate vicinity of the writer's residence at Bethnal Green. He is of the opinion that, as is suggested in the passage quoted above, an agglomeration of the smaller drops took place, increasing the electric tension to such an enormous extent, that a flash escaped in the immediate neighbourhood of the houses struck, and thus entered them.

This country affords much better opportunities than Great Britain for observing the phenomena connected with thunderstorms, on account of their greater frequency and severity, and it is therefore to be desired that some of our scientific men should commence a series of observations with a view of ascertaining whether rain is really the *cause* of lightning.

CONNECTION OF THE AURORA BOREALIS WITH ELECTRICITY.

The connection of the aurora borealis with electricity, a fact which has been taken for granted since the days of Franklin, has only lately been fully established. Mr. E. C. Herrick, of New Haven, has recently observed an electrical action on the wires of the telegraph at that place during the occurrence of an aurora. The same fact has been also noticed in England and on the Continent during the last year. During the aurora of the 17th of November, 1848, the telegraph at Watford, England, was violently affected for many hours. On several occasions the electric current passing was sufficiently powerful to attract the movable armature of the stationary electro-magnet of a bell apparatus, so as to allow the alarm to be sounded. To effect this, the pressure of one third of an ounce was found by experiment to be necessary, and from a calculation based on the length and thickness of the wires, it is supposed that the power of an aurora, if similarly extended over a square mile of surface, would be equivalent to the lifting of seventy-five tons. It has not been fully ascertained, whether the action is one of actual transfer of electricity from the space at one end of the wire to that at the other, whether it is an inductive action of the aurora at a distance, disturbing for an instant the electrical equilibrium of the wire.

A NEW MODE OF DISCHARGING A LEYDEN BATTERY.

We find in the *London Mechanic's Magazine* a notice of a novel method of discharging a Leyden battery, which has lately been exhibited before the Polytechnic Institution. In this new method the jars are arranged in a series, with the knob of each in connection with the outer coating of the next in the series, as has often been done heretofore in the process of charging them. In our case, however, they are charged separately, or are first connected together in a battery in the ordinary way. When ready to be discharged, they are by a simple movement all insulated and arranged in a series as described above, which may be made to take a semicircular or U form, in order to bring the knob of the last jar in the series into convenient proximity to the outer coating of the first jar. The effect of this arrangement is to multiply the intensity in a manner analogous to that of the galvanic battery, so that if the outer coating of the first jar be supposed to be in connection with the earth, and the number of jars be twelve, the knob of the last jar will be twelve times more highly electrified than the knob of either jar was before being thrown into the series. The disruptive or space-penetrating force is consequently

greatly increased, and a battery of twelve large jars is said to have been discharged through a space of about three feet. The *quantity* of the spark, however, is only that of a single jar, and therefore, to pursue experiments satisfactorily, large jars must be used, with an abundant source of electricity from a powerful machine. In order to make the change in the arrangement of the jars, each jar is supported in a horizontal position on a vertical spindle, and a slight turn given to each spindle at once brings them from the position they are placed in for charging into the series described.

ELECTRIC BATTERIES.—DISCOVERY IN PLATING.

AT the late meeting of the British Association Mr. W. S. Ward produced a paper on this subject, and stated that a series of calculations, founded on data, produced to the Chemical Section at Swansea, showed the efficient power of three generally useful forms of battery, known as Smee's, Daniell's, and Grove's, would be equal when 100 pairs of Smee's, 55 pairs of Daniell's, or 34 pairs of Grove's were used, and that the expense of working such batteries, as regards a standard of 60 grains of zinc in each cell per hour, would be about 6*d*., 7½*d*., and 8*d*., respectively.

This communication led to some conversation on the economy of the various batteries, and the processes for plating; in the course of which Mr. Shaw and Dr. Percy instanced the magneto-electric machines which are employed at Birmingham for electro-plating, in which the current cost of the motive power—viz. a steam-engine to put the magneto-electric machine in action—was the only working-cost. Mr. Elkington stated that they had never been induced to abandon the voltaic battery which they employed in their manufactory, finding it more economical than the magneto-electrical machine, of which he was the patentee. He also stated the remarkable fact, that a few drops of the sulphuret of carbon, added to the cyanide of silver, in the decomposing cell, has the property of precipitating the silver perfectly bright, instead of being granulated so dead as it is when thrown down from the solutions ordinarily employed.—*London Athenæum, Sept.*

INGENIOUS APPLICATION OF ELECTRICITY.

THE *London Athenæum* furnishes the following ingenious application of electricity, by means of which signals are given that indicate the pressure of steam in the boiler of an engine. The invention is by Mr. Arthur Dunn. "Tubes being filled with mercury are made part of a galvanic circuit, and connected with bells as the mercury rises from increasing pressure in the boiler; the circuit is thus completed, and the bells respectively rung indicate the amount of pressure. In this way attention is called to the condition of the steam the moment it exceeds its ordinary and safe working condition."

DR. LOCKE'S ELECTRO-CHRONOGRAPH.

It is well known that Congress at its last session appropriated $10,000 to be paid to Dr. Locke for one of his electro-chronographs, to be erected by him at the National Observatory in Washington. This instrument has now been finished in Boston and forwarded to its destination. Much curiosity has been excited in regard to this important invention, and we have compiled from a great variety of sources a description, which it is hoped will serve to convey some idea of the working and purpose of the electro-chronograph.

The object of this instrument is for the determination of the exact period, to the hundredth or even the thousandth part of a second, of a transit or other astronomical observation by which longitude may be ascertained. The difference of longitude of any two places, it is well known, is determined by observing the period of the occurrence of certain celestial phenomena, such as eclipses, transits, occultations, &c. In order to insure perfect accuracy, the utmost exactitude in regard to *time*, even to the fractional part of a second, is desirable. The usual practice has heretofore been for the observer to note the exact time of the transit or other phenomena by listening to the beats of a clock or chronometer, and estimating the fraction of a second between two beats when the event occurs. This requires a nicety of hearing only attained by long practice, and when attained, still far from being a perfect measure of time. By the invention of Dr. Locke, the observer can record the *exact* time on a fillet of paper, without taking his eye from the telescope.

The instrument of Dr. Locke, which he has termed an Electro-Chronograph, is a combination of the magnetic clock, Morse's telegraphic register, and a break-circuit key, or instrument for interrupting the magnetic circuit. The first, or magnetic clock, was invented in England, by Mr. Wheatstone, about the year 1841. An invention of a similar character was also made by Mr. Bond of the Observatory at Cambridge. Its object is to make several clocks on the same telegraph line, even at a distance of hundreds of miles, mark the same instant of time. This is done by breaking the circuit of the magnetic fluid at each second of time. The method of interrupting the circuit in the clock of Dr. Locke is different from that adopted by Wheatstone, and has this advantage that it cannot alter the rate of the most delicate astronomical clock. With this clock is combined a register, by which, instead of the beats of the clock at one extremity of the telegraph line being made *audible* only, as was contemplated by Wheatstone, they are made *visible* as well as audible, by being imprinted on a fillet of paper which revolves around a drum. In the Morse register, when the magnetic circuit is unbroken, a continuous line is made.

The magnetic clock of Dr. Locke interrupts the circuit at each second, and produces breaks which represent the second on the fillet of paper at the other end of the line. The dashes or lines between each break are exactly of a length, and each break represents a second. By

an ingenious arrangement of the machinery, the end of each minute, of each five minutes, and of each hour, is represented, so that the exact period when an observation is made may be determined without counting the seconds. The beginning of a minute is recorded by the omission of a break between two seconds, when the confluent lines extend, say an inch. The commencement of an hour is indicated by a line of double the length of the five-minute line.

The remaining part of this chronograph is the break-circuit key, by which the period when an observation is made is determined. The astronomer at any station on a line of several thousand miles in length, may imprint on the register the date of any event by simply tapping, after the manner of playing upon a piano, upon a *break-circuit key.* This imprints in the indented line a corresponding *break-circuit space.* Two or three spaces may be printed in one second, if desired. Two seconds of time is ample for the equatorial interval of the wires of a transit instrument. The net-work of spider lines is divided into some nine or more tallies, or distinct groups of five wires each. All these tallies in the case of the transit of a star are imprinted on the register, in the time occupied by the ordinary method for a single tally, to which a transit has been usually limited. The skill required for tapping on the key at the instant of the bisection of a star is easily acquired, and the accuracy of each imprint is much greater than that of a single record by the common method. The imprints furnish a perpetual record of the date of the event, and may be read off with great rapidity to the hundredth of a second, by means of a graduated scale of the paper used for registering.

Those who understand the general principles of the magnetic telegraph will readily comprehend the main principles of this invention. The value of it can only be estimated by the astronomer. In determining longitude, the observations of many nights, even for years, have heretofore been necessary in order to secure accuracy. With one of the clocks of Dr. Locke, the difference of longitude between the National Observatory at Washington and any other point reached by magnetic telegraph may be determined in *one night* so closely *as to show in what part of the building the observations were made.*

Lieut. Maury, in a letter to the Navy Department, after describing the instrument, says:—"Its powers are such that the astronomer in New Orleans, St. Louis, Boston, and every other place to which the magnetic telegraph reaches, may make his observations, and at the same moment cause this clock, here in Washington, to record the instant with wonderful precision. Thus, the astronomer in Boston observes the transit of a star as it flits through the field of his instrument and crosses the meridian of that place. Instead of looking at a clock before him, and noting the time in the usual way, he touches a key, and the clock here subdivides his seconds to the minutest fraction, and records the time with unerring accuracy. The astronomer in Washington waits for the same star to cross his meridian, and, as it does, Dr. Locke's magnetic clock is again touched; it divides the seconds and records the time for him with equal precision. The difference between these two times is the longitude of Boston from the

ridian of Washington. The astronomer in New Orleans, and St. Louis, and every other place within the reach of the magnetic wires, may wait for the same star, and, as it comes to their meridian, they have but to touch the key, and straightway this central magnetic clock tells their longitude.

"And thus this problem, which has vexed astronomers and navigators, and perplexed the world for ages, is reduced at once, by American ingenuity, to a form and method the most simple and accurate. While the process is so much simplified, the results are greatly refined. *In one night the longitude may now be determined with far more accuracy by means of the magnetic telegraph and clock than it can by years of observation according to any other method that has ever been tried.*"

In a later letter Lieut. Maury says: — "The magnetic telegraph now extends through all the States of the Union, except, perhaps, Arkansas, Texas, and on the frontier; so that a splendid field is presented for doing the world a service by connecting, for difference of longitude through means of the magnetic telegraph and clock, all the principal points of this country with this Observatory (Washington). In anticipation of such extension of the wires, I ordered an instrument for the purpose, and it has recently arrived. It is intended to determine *latitude* also,—so that by its means and this clock I hope, during the year, to know pretty accurately the geographical position of Montreal, Boston, Chicago, St. Louis, New Orleans, &c., and their difference of longitude from this place, quite as correctly as the difference between Greenwich and Paris has been established by the usual method and after many years of observation."

THE COPYING ELECTRO-TELEGRAPH.

The specification of the invention, by means of which a letter written in London may be copied *verbatim et literatim* in Liverpool, discloses the means by which this is to be accomplished. Wonderful as it seems, to have the power of producing a *fac-simile of writing* instantaneously at any distance, the mode of operation is extremely simple. The writing materials consist of tinfoil, varnish, and a quill pen. The letter thus written is applied to a cylinder; a metal style or point presses on the writing as the cylinder revolves; and the point being attached to a screw, it moves gradually along from one end of the cylinder to the other. The thread of the screw is sufficiently fine for the point to traverse six or seven times over each line of writing before it passes by the revolution of the cylinder to the next. The point is connected with one pole of a voltaic battery, and the cylinder is connected with the other pole, so that the electric current may pass from the former to the latter; but as varnish is a non-conductor of electricity, the circuit is interrupted whenever the point presses on the varnish-writing. The distant telegraphic instrument is an exact counterpart of the one that transmits; but, in place of the tinfoil, paper, moistened with a solution readily decomposed by electricity, is applied to the cylinder. Thus the electric current trans-

mitted through the ordinary telegraphic wires is made to pass from the metal points to the cylinders of the two instruments, through the interposed moistened paper on one, and through the tinfoil on the other. When the metal point of the transmitting instrument is pressing on the bare tinfoil, the electric circuit is completed through the paper on the distant cylinder, and by the decomposition of the solution a mark is made; when the point is pressing on the varnish, the circuit is interrupted and the marking ceases. In this manner, the point of the transmitting instrument, by passing several times over each line in different parts from the top to the bottom, produces an exact copy of the forms of the letters; the writing appearing pale-colored on a dark blue ground, consisting of numerous lines made spirally round the cylinder.

It is essential to the correct working of the instruments that they should rotate exactly together, and this Mr. Bakewell has accomplished by the regulating power of electro-magnets brought into action at regular intervals by means of pendulums. By means of a guide-line the operator at the copying-station can tell with accuracy whether his instrument is moving faster or slower than the other, and thus regulate the pendulum. Cylinders six inches in diameter may be regulated to revolve thirty times in a minute and produce distinct copies of writing. The rate of copying gives 400 letters per minute with a single wire, and with two wires and two points that number would be doubled. — *London Spectator, June* 23.

NEW TELEGRAPH.

A Mr. Johnson, of Oswego, has invented a new machine for telegraphic purposes. The principle of it is new, in the fact that it uses shot, or the dropping of shot, to make marks, indentations, or signs, on a white sheet of paper. The motive-power of electricity, or of magnetism, Mr. Morse does not presume to patent, but he has patented the use of it for making signs, and what we call the power of invigorating the current of electricity by relays of batteries. Mr. Johnson uses the common motive-power of electricity to drop his shot, but when the shot are dropped, then another very simple arrangement makes with them the mark on the paper. These shot return in an ever-revolving wheel, and thirty of them do all the work.

THE COAST SURVEY AND THE MAGNETIC TELEGRAPH.

On the fourth day of the sitting of the American Association at Cambridge, Mr. S. C. Walker, Assistant of the U. S. Coast Survey, at the direction of the Superintendent, communicated the substance of his recent Report on the Experience of the Coast Survey in regard to Telegraphic Operations. We give all that seems important.

"The first mention of the electro-magnetic telegraph, in connection with longitude operations, as far as I know, was made, in 1837, by M. Arago to Dr. Morse. The first practical application of the method was by Capt. Wilkes, in 1844, between Washington and Bal-

timore. Two chronometers, previously rated by astronomical observations in the vicinity, were brought to the two telegraph offices, and were compared together through the medium of the ear, without coincidence of beats. This process is accurate enough for geographical or nautical purposes; but its precision stops short of the mark where the requirements of geodesy begin. In fact, two clocks beating the same kind of time, when placed side by side, cannot be compared together, by the human ear, with sufficient precision for geodetical purposes. The subsequent experience of the Coast Survey has shown, that where several astronomers make independent comparisons of clocks, in this manner, two seconds of arc, or twelve hundredths of a second of time, is an average discrepancy between their results.

"The subject of telegraph operations for longitude had engaged the attention of the Superintendent of the Coast Survey previous to the experiment of Capt. Wilkes; but the orders received by me for this purpose bear date November 24, 1845. In 1846, the very first season in which two astronomical stations of the Survey were brought in connection by the Morse telegraph lines, the work of connecting them together in longitude was commenced in earnest by the Superintendent of the Coast Survey. The coöperation of the National Observatory, as one of the stations, was freely tendered by its Superintendent, Lieut. Maury, U. S. N., and accepted by Prof. Bache. Another station was established at Philadelphia, under the superintendence of Prof. Kendall, and still another at Jersey City under Prof. Loomis.

"Owing to the imperfect insulation of the lines, the connection of Jersey City with Washington failed that year; but the Washington and Philadelphia stations were connected together astronomically on the 10th and 22d of October. The method of comparison by coincidence of beats of solar and sidereal timekeepers, was not introduced this year; but the equivalent one was employed, viz., the exchange of star-signals. These are the dates of instants of the passage of a star over the wires of the eye-piece of the transit instrument, signalized by tapping on the telegraph key at one station, and recording it on the Morse register at both.

"In 1846, we connected together in longitude the Washington and Philadelphia stations. In 1847, the programme left unfinished in 1846, by the imperfection of the lines, was resumed and completed, and Washington, Philadelphia, and Jersey City were connected together. On the 27th July, 1847, the method of coincidence of beats, used so successfully by R. T. Paine, Esq., in the chronometric operations for longitude in Massachusetts, and by Struve and Airy in their chronometric enterprises, was applied to the telegraphic comparisons of the Philadelphia and Jersey City clocks. This method of coincidence was used in combination with exchanges of star signals, in the telegraphic operations of the Coast Survey in 1848, when the Cambridge observatory, under Prof. Bond, and the Stuyvesant Station in New York, were connected together by the Coast Survey.

"In October, 1848, Cincinnati was connected with Philadelphia.

The labors of the year 1848 comprise some 1,800 observed transits of stars, 800 comparisons of chronometers by coincidences of beats taken at the stations, 5,000 transits over wires, for determining the personal equations of the officers of the Survey, many thousand exchanges of personal clock signals, and 600 star-transit signals. If even this prodigious accumulation of statistics was considered a gain of many fold over the old method of obtaining astronomical longitudes, what shall we say of the automatic process employed in 1849, where one night's exchange of star signals between Philadelphia and the Seaton Station, printed automatically on a single sheet of paper, is worth the whole list of statistics collected by the Coast Survey between Philadelphia and Washington in 1847?

"In my report of December 15, 1848, feeling the responsibility under which I acted, I spoke with caution on the subject of the comparative excellence of the automatic printing method; though some of my friends thought that its merits were overrated. I appealed to the experiments that were to be made in the campaigns of 1849 for a test of the new method. That which was then anticipation only, is now reality; and I am able to say, from recent trials, between Cambridge and Washington, and between the Seaton Station under my care at Washington, and the stations at Philadelphia, and at Hudson, Ohio, that the excellence of the new method surpasses all that I ventured to hope for in December last. I then ventured to claim for the automatic printing method a tenfold gain over the old one. I now find that one transit over one wire is worth four wires by the old method, and that ten transits over wires may now be printed, where one was done before; making a gain by the new or automatic method of some forty fold. I mean by this the gain from multiplication of transit over wires, and superior precision of each. We cannot in one night obtain the advantage of the average of the meteorological peculiarities of forty."

After enumerating the registers of Morse, of Mitchell, and the chemical method of registering with the main circuit, he says:—"The fourth form of the register is Mr. Saxton's invention of this year. It is somewhat on the plan of his celebrated ruling-machine. The cylinder now before the Association contains the culmination of the planet Neptune and the stars near his parallel, printed by me at the Seaton Station, August 11, 1849. It might seem that the subject of the place of the planet Neptune is foreign to the purpose of telegraph operations. Such is not the case; for we have used this planet as a fundamental star. I take occasion, therefore, to remark, that the observations of the culmination of Neptune on four nights in the month of August at the Seaton Station, by Pourtalès and myself, show that my ephemeris, published by Prof. Henry in the Smithsonian Contributions to Science, agrees with the heavens within half a second of arc. From this close agreement it may be inferred, that, if the Neptune of Prof. Peirce's theory and my elements were conceived to be a planet, placed side by side in the heavens with the true one ever since its discovery, the two would form a double star of an order so close that not even the great Cambridge refractor could detect their duplicity.

"An objection has been raised to the Morse registering fillet, that it is too voluminous for the quantity of matter recorded. This objection, and that of expensiveness, apply with more force to the metallic cylinder, however accurate be its indications. To remedy this evil Mr. Saxton has contrived a sheet of paper which incloses the cylinder and lasts for about two hours of constant work. The sheets and registering fillets now submitted for the inspection of the Association contain the comparison of the printed record of the culmination of the stars in the Dolphin. The Saxton sheet, the chemical fillet, and the Morse fillet, are triplicate records of the same identical star-signals. The result of the reading, as far as experiments have been made, is, that all kinds of registers at the same place read alike. It is worthy of remark, that these registers contain the printed record of the transits of both components of the double star Gamma Delphini, printed with ease on each of the forty-five wires of the Wurdemann's diaphragm, making ninety imprints in a culmination. From my experience in printing the transit of this pair of double stars, I am led to the conclusion, that four stars forming a quadruple star, when at proper distance, may all be printed at the time of their transit over a diaphragm of fifty wires, making two hundred imprints for one transit, a rapidity of playing on the key far below that of good execution on the piano.

"Of the different kinds of registers I prefer the sheet of Mr. Saxton. One sheet filled on both sides, or two pages, will contain an ordinary night's work. A year's work will make a book of some three hundred pages, on the margin of which may be entered the ordinary remarks for an observing-book, relative to the state of the level and meteorological instruments, name of stars observed, and instrumental deviations. If folded up, or bound and put away for a century, the reduction of the work will then be as easy as at first. In fact, we may, with the metallic cylinder, electrotype the plate; or, using copper, we may print from it without. And, in the case of the paper sheet, instead of Saxton's graver, with Indian ink, we may employ a pen, with lithographic ink, and multiply copies at pleasure, whenever we choose. When we consider the compactness of the register on Saxton's sheet, we may perhaps find that the publication of transit observations will best be made by the lithographic process, applied to the printed telegraph sheets; thus giving to the world the printed record with all the accuracy of a Daguerreotype. The registering fillet now exhibited to the Association contains the culmination of both limbs of the moon, printed by myself, on the 3rd of August last, on 35 wires of the diaphragm. By the mean of the results, the probable error of the imprint of a transit of a single limb over a single wire is the sixteenth of a second; whereas, in 1846, with the great Washington Equatorial, and a power of 300, I found that, with the old method, my probable error, by 66 trials, was twice as great, namely, the eighth of a second. Thus it appears that the measure of precision is twice, and the weight four times, as great, in the new method, as in the old. No labor of training for the work is needed.

"A hundred wires is a high estimate for a night's work of an obser-

vatory, by the old method. I have printed fifteen hundred wires without fatigue, in one night, by the new. Since each wire is worth four of those of the old method, we have six thousand to one hundred, or sixty to one, as the relative efficiencies of the night's observations.

"When we reflect that the probable error of one transit over one wire is only the sixteenth of a second, and that with five wires it is only a thirty-sixth part, or three hundredth of a second, it is manifest that one tally, or five wires, is ample for all ordinary work. In fact, one wire is sufficient for most of the purposes of astronomy. I have been led, on consideration of all the facts known from the experience of the Coast Survey, to make the following remark relative to the precision of our work, after proper adjustment of the transit instrument, or measurement of its deviations from a normal state:—*The printed transit of a fundamental star over any one wire of Wurdemann's diaphragm, and that of a star, planet, or comet, whose place is sought, over another wire,—both reduced to the centre, on the supposition of uniformity of interval,—give the place of the object sought with a precision not much below that on which rest the present elements of all the bodies in the solar system.*"

SUBMARINE TELEGRAPH BETWEEN ENGLAND AND FRANCE.

A GENTLEMAN by the name of Brett has obtained from the French government the authorization to establish an electric telegraph between Calais and Boulogne, which, crossing the Channel under the water, will go to Dover on the coast of England. The arrangement entered into guarantees certain advantages to the French government, and leaves all the expense to Mr. Brett, securing him, however, a privilege for ten years, in case the experiment should succeed. The work must be terminated by the 1st of September, 1850, at the latest.

Experiments to test the practicability of effecting an electric communication beneath the surface of the ocean, for considerable distances, have recently been made at the harbor of Folkestone, England. Upwards of two miles of wire, coated with gutta-percha, were submerged in the sea along the mouth of the harbour. One end of the wire was connected with a telegraphic instrument on the deck of a steamer, and the other end with a wire communicating with the London telegraph. Messages were sent back and forth with no greater difficulty than with the ordinary wires on land. The insulation effected by gutta-percha is, no doubt, most perfect. The experiments of Faraday have shown that it is one of the most perfect electrical insulations with which we are acquainted. How far it may be acted upon by the chlorine, iodine, &c., contained in sea waters, is a question which has not yet been solved.

The wire used in this experiment was, when covered with gutta-percha, about a quarter of an inch in diameter; but this is much smaller than that which it is proposed to stretch across the Channel. It is believed that the kind of wire proper to be used, is the twisted iron wire, coated so thickly with gutta-percha as to be nearly three quarters of an inch in diameter. In order to guard against interrup-

tion, such as would be liable to arise from the fracture of the wire, it is proposed to stretch two or three lines across the Channel, in different places, at such distances from each other as to render it improbable that all would be broken the same day. In the event of one being fractured, a repair could be easily effected in a short time, by means of steamers, kept continually in readiness on both sides of the Channel, for fishing up and discovering the broken wire. The immense business of a line of telegraph between London and Paris would, it is thought, justify a much greater expense than is involved in the arrangement indicated.—*English Paper.*

DISCOVERIES IN MAGNETISM.

Bertin, in an examination of the rotation of the plane of polarization by the electro-magnet, or the wire helix, has been the first to establish, under various circumstances, the law, that the rotation is always in the direction of the magnetizing current, or of the currents which, according to Ampère, would be set up, under the influence of the electro-magnet, in a piece of soft iron, placed in the position of the substance employed.

It was considered, till lately, as an established fact, that the magnetism of steel magnets was entirely destroyed by a white heat, and that at this temperature even iron no longer obeyed the attraction of the magnet. Pouillet, indeed, had stated that cobalt remained magnetic even at a very high temperature, but that, on the contrary, the magnetism of chromium disappeared at a heat somewhat below redness, and that of nickel at 350°. Recently, however, Faraday has found by experiments with powerful electro-magnets, that even white-hot iron, and nickel heated far above 350°, still followed the attraction; and Plücker has more closely examined the behaviour of the magnetic and diamagnetic properties under increasing temperature.

Faraday considered that it might be concluded from his experiments, that by an appropriate mixture of magnetic and diamagnetic substances, a perfectly neutral body might be produced; Plücker, however, has been led by his observations to an opposite conclusion. The latter concludes, from a variety of experiments, that the diamagnetism increases more rapidly than the magnetism, with an increasing power in the electro-magnet; and he considers it to be quite indifferent whether the increase of the intensity arises from the employment of a greater number of cells, or from a closer approximation to the poles. If these results are perfectly accurate, no absolutely neutral body can exist; for a body which behaves as neutral at any given distance will be magnetic at a greater, diamagnetic at a less distance. —*Liebig's Annual Report.*

ACTION OF MAGNETISM ON ALL BODIES.

At the meeting of the Paris Academy of Sciences, on May 21st, M. Edmond Becquerel communicated a paper upon the effects of magnetism upon all bodies. The following are his deductions:—

"1. All bodies become magnetic, as soft iron does, under the influence of a magnet, but in greater or less degree according to their nature. 2. The temporary magnetism of a body does not depend upon its mass, but on the manner in which the ether is distributed in the body. 3. A substance is drawn towards a magnetic centre by the difference of the actions exerted upon the substance and upon the volume of the medium displaced by it." The effects were measured by the tension developed upon small bars of the various substances by an enormous electro-magnet. The continual oscillations are prevented by suspending under each bar a small sphere of lead or zinc, immersed in water or a solution of chloride of calcium.

"Measuring, in this way, the actions exerted upon substances moving in different media, I convinced myself of the enormous influence exerted by the surrounding medium. Thus, common glass, which in the air is attracted by the two poles of a magnet, is strongly repelled by these same poles when in solutions of iron or nickel; sulphur and white wax, which in the air are repelled by the centres of magnetic action, are attracted when they are immersed in concentrated solutions of chloride of calcium or chloride of magnesium." Upon the third general law announced above, he says,—"Thus, a body is attracted or repelled by a magnetic centre, according as it is immersed in a medium less or more magnetic than itself. Hence it results that the attractions and repulsions exerted upon different bodies by either pole of a magnet near which they are brought, depend upon the same cause, and not upon two orders of phenomena." To explain the fact, that all bodies are not attracted *in vacuo*, and that some substances are almost as much repelled *in vacuo* as in air, "it is necessary to admit that the ethereal medium by means of which magnetic actions are transmitted is influenced in the same way, but in a different degree, in a void space and in one containing matter; and that a void space behaves like a medium more magnetic than the substance which is most repelled, that is to say, bismuth. Certain gases, as nitrogen, nitrous oxide, &c., experience no appreciable action from magnetism, but oxygen does, and the slight magnetic power of the air is due solely to the presence of oxygen. I found that a small bar of charcoal, which has condensed oxygen, oscillates between the poles of a strong magnet like a small magnetised bar, whilst *in vacuo* it is generally repelled, and always feebly influenced, by the action of magnetism."

"Comparing the power of oxygen with that of iron, we conclude that 10.78 cubic feet of air has an action represented by 1.65 grain of iron. If we reflect that the earth is surrounded by a mass of air, equal in weight to a stratum of mercury 30.4 inches in depth, it may be asked whether such a mass of magnetic gas does not interfere in the phenomena dependent on terrestrial magnetism, and perhaps in the diurnal variations of the magnetic needle; and if we calculate the magnetic power of this fluid mass, we find it equivalent to an immense sheet of iron, rather more than 0.004 of an inch in thickness, and covering the whole surface of the globe." The author concludes by saying,—"I do not, therefore, admit any difference between *diamagnetism* and *magnetism* proper."

THE MAGNETIC RELATIONS OF THE POSITIVE AND NEGATIVE OPTIC AXES OF CRYSTALS.

Mr. Faraday's discovery of diamagnetic phenomena is likely to lead rapidly to some important knowledge of the molecular forces which determine the conditions of the material creation. Plücker, of Bonn, in a letter to a friend, says:—"I replace the declination-needle by certain crystals suspended horizontally by a fibre of cocoon silk. They take under the action of the earth's magnetism, a determinate and fixed direction. I can vary at will, and predict this with certainty; and obtain crystals to act as needles which shall point constantly towards the poles of the earth, towards the magnetic poles, or towards some azimuthal point."

In a later letter to Dr. Faraday, Plücker says,—"The first and general law I deduced from my last experiments is the following. There will be *either repulsion or attraction* of the optic axes by the poles of a magnet, according to the crystalline structure of the crystal. If the crystal is a *negative* one, there will be *repulsion;* if it is a *positive* one, there will be *attraction.*" After some other remarks, he continues,—"Cyanite is by far the most interesting crystal I have examined. It points very well to the north *by the magnetic power of the earth only.* It is a true compass-needle, and more than that, you may obtain its declination. The crystal does not point according to the magnetism of its substance, *but only in obedience to the magnetic action upon its optical axes.* If you approach to the north end of the suspended crystal the south pole of a permanent magnetic bar, strong enough to overpower the magnetism of the earth, the axis of the prism will make with the axis of the bar an angle exactly *the same* as it made before with the meridian plane, the crystal being directed either more towards the east, or more towards the west. The crystal, resembling in that also a magnetic needle, showed strong polarity; the same end being always directed to the north. I think this may be a *polarity of the opto-magnetic power.* Between the poles of the strong electro-magnet, the permanent polarity disappeared as long as the magnetism was excited."

Mr. Alger, in communicating to the American Association these discoveries of Plücker, made some remarks concerning cyanite, which may perhaps render the subject a little clearer. He said, referring to the effect observed,—"This is, of course, founded on the recently discovered magnetic property of aluminum, but in the highly oxidized state in which this metal exists in cyanite, it would hardly seem possible that the direction which the crystal assumes should be due to its metallic base; nor can we suppose the presence of iron in sufficient quantity to cause it; yet we must place confidence in so high an authority. Plücker finds, also, that there is some connection between the direction that cyanite assumes and its cleavage planes." The subject deserves further investigation, and Mr. Alger recommended American mineralogists to examine other aluminous minerals of the same class with respect to their magnetism.

ON THE CRYSTALLINE POLARITY OF BISMUTH.

We find in the *Philosophical Transactions* for 1849, Part I., a long paper by Prof. Faraday, "On the Crystalline Polarity of Bismuth and other Bodies, and on its Relation to the Magnetic Form of Force." The author states, that in preparing cylinders of bismuth, by casting them in glass tubes, he had often been embarrassed by the anomalous magnetic results which they gave, and that, after a close investigation, he has referred the effects to the crystalline condition of the bismuth. If bismuth be crystallized in the ordinary way, and then a crystal, or a group of symmetric crystals, be selected and suspended in the magnetic field between horizontal poles, it immediately either points in a given direction, or vibrates about a given position, as a small magnetic needle would do; and if disturbed from this position, it returns to it. On re-suspending the crystal, so that the horizontal line, which is transverse to the magnetic axis, shall become the vertical line, the crystal then points with its maximum degree of force. If it be again suspended so that the line parallel to the magnetic axis be rendered vertical, the crystal loses all directive force. This line of direction, therefore, which tends to place itself parallel to the magnetic axis, the author calls the *magnecrystallic axis* of the crystal. It is perpendicular or nearly so, to the brightest and most perfect of the four cleavage planes of the crystal. Whether this magnecrystallic axis is parallel or transverse to the magnetic axis, the bismuth is in both cases repelled from a single or the stronger pole; its diamagnetic relations being in no way affected. If the crystal be broken up, or if it be fused and solidified, and the metal be then subjected to the action of the magnet, the diamagnetic phenomena remain, but the magnecrystallic results disappear, because of the confused and opposing crystalline condition of the various parts.—If an ingot of bismuth be broken up, and fragmentary plates selected which are crystallized uniformly throughout, these also point; the magnecrystallic axis being, as before, perpendicular to the chief plane of cleavage, and the external form, in this respect, of no consequence.

The position of the crystal in the magnetic field is affected by the approximation of extra magnets or of soft iron; but the author believes this to result, not from any attractive or repulsive force exerted on the bismuth, but only from the disturbance of the lines of force, or resultants of magnetic action, by which they acquire, as it were, new directions; and as the law of action which he gives is, that *the line or axis of magnecrystallic force tends to place itself parallel, or as a tangent, to the magnetic curve, or line of magnetic force, passing through the place where the crystal is situated*, so the crystal changes its position with any change of direction in these lines.

Crystals of antimony, arsenic, native crystals of iridium and osmium, and crystallized titanium and tellurium, gave similar results, but in different degrees. Crystals of zinc, copper, tin, lead, gold, &c., gave no signs of being magnecrystallic. Crystals of sulphate of iron are very strongly affected by the magnet according to this new condition, and the magnecrystallic axis is perpendicular to two of the planes of

the rhomboidal prism, so that, when a long crystal is used, it will not, as a mass, point between the poles, but across the line joining them. On the other hand, sulphate of nickel has its magnecrystallic axis parallel, or nearly so, to the length of the ordinary prism. Diamond, rock-salt, fluor-spar, boracite, red oxide of copper, oxide of tin, cinnabar, galena, and many other bodies, presented no evidence of the magnecrystallic condition.

Having thus stated the effects produced, Dr. F. enters upon the consideration of the nature of the magnecrystallic force. He found that bismuth has the same amount of repulsion when presenting its magnecrystallic axis parallel or transverse to the lines of magnetic force acting on it, and he was led by an ingenious series of experiments to conclude that it is neither attraction nor repulsion which determines the final position of a magnecrystallic body.

He next considers it as a force dependent upon the crystalline condition of the body, and, therefore, associated with the original molecular forces of the matter, and shows experimentally, that, as the magnet can move a crystal, so also the crystal can move a magnet; and, also, that heat takes away this power just before the crystal fuses, and that cooling restores it in its original direction. Coming next to the question, whether the effects are due to a force altogether inherent in the crystal, or whether they are not partly induced by the magnetic or electric forces, he concludes that the force manifested in the magnetic field, which appears by external actions, and causes the motion of the mass, is almost entirely *induced*, in a manner subject, indeed, to the crystalline force and additive to it, but at the same time exalting the force and the effects to a degree which they could not have approached without the induction. To this part of the force he applies the word *magneto-crystallic*, in contradistinction from the word *magnecrystallic*, which is used to express the condition, quality, or power which belongs essentially to the crystal. The author then continues his investigations, and concludes with some appropriate remarks on the progress recently made in the knowledge of magnetism, its powers and effects.

MAGNETIC ACTION ON RAILWAYS.

It is well known that an opinion has prevailed among scientific men for a few years, that railway axles, after having been used for some time, become crystallized by galvanic action, and are then very easy of fracture. The subject was brought before the late meeting of the British Association by Mr. Greener, who, without questioning the fact, stated that the axles were affected with electricity generated by the bearings and the journal while in rapid motion. He said, that by subjecting inferior iron to currents of electricity, it was soon changed into a crystalline state, and lost its tenacity.

Mr. Stephenson said, that it was dangerous to assume facts and reasoning from the assumptions of Mr. Greener. With respect to the influence of vibration on the structure of iron, he considered that there was good room to doubt that the bearing force or pressure upon metals caused crystallization. It was by no means proved that railway axles

were subject to the passage of currents of electricity, and therefore—granting the assumption that the passage of the electric current changed the character of the iron—there was a link wanting in the chain of reasoning, inasmuch as it was not proved that axles were subject to this electrical influence. Moreover, he was inclined to doubt whether, if a piece of iron was at first perfectly fibrous, vibration would ever change the structure of the metal. The beams of Cornish engines, for example, were subject to vast pressure; they never become crystallized: the connecting-rod of a locomotive was subject to great vibration, strain, and pressure, vibrating eight times a second when the velocity is forty miles an hour; he had watched the wear of a rod for three years, and no change was perceptible in the structure of the iron.

SELF-REGISTERING MAGNETIC NEEDLE.

One source of error has constantly attended magnetic observations in the most perfectly constructed observatories. The approach even of the observer has been sufficient to produce a disturbance in the magnetic needles or bars. This error, however, no longer exists. Each magnetic bar is made to carry a little mirror, which reflects the light of a lamp upon a piece of photographic paper kept constantly moving behind an opaque plate having but one small vertical opening. On this, for every minute of the twenty-four hours, each vibration of the needle is faithfully recorded. The chemical radiations of an Argand lamp supply the observer's place; and at the same time, as it records every change in the phenomenon of terrestrial magnetism, it is made to mark the most delicate alternations in atmospheric pressure, and to note every increase or diminution of temperature. At Greenwich, the magnets, the barometers, and the thermometers are all registered by the chemical power of light; and M. Faye and Gonjon, at Paris, knowing the error of the human eye in observations on a bright object, have substituted the Daguerreotype plate for the purpose of ascertaining the actual diameter of the sun, and they propose to the principal observatories of Europe to determine by a similar method the absolute time. Electricity now determines the longitude, and marks the transit of a star, and the sun's rays perform equally important offices to aid the natural philosopher in his delicate research for the truths which are as yet obscure.—*London Athenæum, March.*

MAGNETIZED BRASS.

Rev. Mr. Rankin stated at the last meeting of the British Association, that he had found the northern half of a brazen meridian of a celestial globe to be so strongly magnetic as to deflect a small needle placed near it so much as eight points from its true direction, while the southern part of it seemed to be wholly free from magnetism.—*London Athenæum.*

ON THE DIURNAL VARIATIONS IN THE DECLINATION OF THE MAGNETIC NEEDLE, ETC.

Professor W. A. Norton, of Delaware College, has communicated to *Silliman's Journal* a long and interesting article upon this subject, which is at present exciting much discussion. He says:— "In a former memoir I gave an exposition of a new theory of Terrestrial Magnetism, of which the following are the fundamental principles. 1. Every particle of matter at the earth's surface, and to a certain extent below the surface, is the centre of a magnetic force exerted tangentially to the circumference of every vertical circle that may be conceived to be traced around it. 2. The direction of this force is different, according as it solicits the north or south end of the needle; and it is always such, that to the north of the acting particle the tendency is to urge the north end of the needle downward and the south end upward, and to the south of the same particle it is the opposite. 3. The intensity of the magnetic force of a particle of the earth, at a given distance, is approximately proportional to its temperature, or amount of sensible heat; and at increasing distances diminishes according to some unknown law. From these principles I deduced three simple formulæ; one, for the horizontal component of the directive force of the needle, or the horizontal magnetic intensity of the place; a second, for the vertical intensity; and a third, making known the declination. These formulæ were afterwards tested by numerous comparisons with the results of observations made in every variety of locality in the northern hemisphere of the earth. The agreement was found to be very close,—the differences amounting only to a few hundredths for the horizontal and vertical forces, and less than 2° 40′, and in most cases less than 1°, for the declination. The positions of the magnetic poles, the pole of maximum intensity, and the magnetic equator, were also theoretically deduced, and shown to correspond very closely with their observed positions.

"In view of the whole discussion, the following great truths were supposed to have been established. 1. All the magnetic elements of any place on the earth may be deduced from the thermal elements of the same; and all the great features of the distribution of the earth's magnetism may be theoretically derived from certain prominent features in the distribution of its heat. 2. Of the magnetic elements, the horizontal intensity is nearly proportional to the mean temperature, as measured by a Fahrenheit thermometer; the vertical intensity is nearly proportional to the difference between the mean temperatures at two points situated at equal distances north and south of the place, in a direction perpendicular to the isogeothermal line (that is, a line conceived to be traced through all points at which the mean temperature of the matter of the earth near its surface is the same as at the station of the needle); and in general the direction of the needle is nearly at right angles to the isogeothermal line. 3. As a consequence, the laws of the terrestrial distribution of the physical principles of magnetism and of heat must be the same, or nearly the same; and these principles themselves must be physically connected in the most inti-

mate manner. 4. The principle of terrestrial magnetism, in so far as the phenomena of the magnetic needle are concerned, must be confined to the earth's surface, or to a comparatively thin stratum of the mass of the earth. 5. The mechanical theory of terrestrial magnetism, which has been under discussion, must be true in all its essential features. 6. We may derive the magnetic elements by very simple formulæ from a very small number of magnetic data, determined by observation and the mean annual temperature of the place.

"From the theoretical investigation of the normal state of the terrestrial magnetic elements, I propose now to proceed to the discussion in the light of the same theory of their diurnal variations. This theory furnishes us the following general principles as a basis for this discussion. 1. The horizontal magnetic intensity is proportional to its temperature. 2. The vertical intensity is proportional to the difference between the temperatures of two places situated at equal distances north and south of the isogeothermal line, in a direction perpendicular to it. 3. The direction of the needle is nearly perpendicular to the isogeothermal line. From these general principles we may draw the general conclusions, that the variations of the horizontal and vertical magnetic intensities must be linked to the variations of the temperature of the station of the needle and of the differences of temperature of places north and south of this, and that the variations of declination must be connected with the variations in the position of the ideal line passing through all places which have the same actual temperature as the given place; which line may be called the *true* isogeothermal line. If the latter conclusion be true, it may be added, that the variations of declination must also be connected with the variations in the differences of temperature of places situated to the east and west of the station of the needle."

Professor Norton then gives a formula for the horizontal intensity of a place, furnished by the above theory, which is equivalent to the statement, that the mean horizontal magnetic force is proportional to the mean temperature. "We have, therefore, to compare the diurnal variations of the horizontal force with those of the temperature of the place. The theory strictly requires that the comparison should be with the daily variations in the absolute amount of sensible heat near the earth's surface, but from well-known facts it is evident that a rise or fall of surface-temperature will, in general, indicate an increase or decrease of the total amount of heat. This suffices for the inquiry which first arises, viz., whether the horizontal force increases and decreases with the total amount of heat." Professor N. then compares some curves arranged so as to show the mean daily variation of the horizontal intensity with that of the temperature for the year 1844. It is found that the horizontal intensity attains its maximum from 3 to 4 P. M., and that "the maximum temperature occurs at the same hour; also that the intensity increases with the temperature in the forenoon after 10 o'clock, and decreases with it in the afternoon and evening. The same correspondences are found in other years and quarters of years, with the qualification that the maximum *horizontal intensity* sometimes occurs an hour or two later than the

maximum of temperature. They indicate that the daily variation of temperature is probably one cause of the variation of intensity. We find, further, that the horizontal force increases during the latter half of the night, till 5 or 6 A. M., and then decreases till 10 A. M., whereas the temperature falls steadily till 5 or 6 A. M., and after that begins to rise. Thus, in the one case there are two maxima and two minima, and in the other, only one of each. Again, while the temperature falls in the afternoon and evening as rapidly as it rises in the forenoon, the horizontal force decreases less rapidly during the former period than it increases during the latter; and, as intimated, the maximum of intensity is sometimes an hour or two later than the maximum of temperature."

Here are discrepancies between the actual and the theoretical variations of the horizontal force which are to be accounted for. Professor Norton calls them *secondary variations*, merely to distinguish them, without intending to imply that they are of minor importance. The inevitable inference from these discrepancies is, that if the daily variation of temperature is one cause of the daily variation of the horizontal force, there must also be some other cause at work besides this. It seems probable, for various reasons, that this additional cause is merely some indirect effect of the variation of temperature; the chief reason is, that the time of the secondary maximum of intensity moves backwards and forwards with the time of sunrise. Professor Norton then examines the subject with great minuteness by means of tables and facts; he takes up the arguments for and against various causes, examines into the laws of the radiation of heat, and finally says,—"In view of all that has now been stated, it may be confidently affirmed, that if the cause of the two anomalous facts connected with the nocturnal loss of temperature be any meteorological phenomenon, it must be the deposition of vapor from the atmosphere in other forms than that of rain, and chiefly, therefore, in the form of dew. Either this must be the actual cause, or it must consist in the laws of the earth's cooling at night, irrespective of all atmospheric influences." A little further on he states his conclusion in somewhat different words. "I conclude that the cause of the nocturnal variations of the horizontal force must either consist in variations in the amount of vapor deposited from the atmosphere, or be in some way connected with the upward flow of heat below the earth's surface." The author then takes up this latter alternative of the upward flow of heat, and concludes that it "fails entirely to explain the unequal losses of temperature at night in different seasons of the year."

Having come to this conclusion, that the secondary variations can be accounted for by nothing else than by the variation in the amount of dew deposited in different seasons, and in different hours of the night, and the consequent variation in the quantity of heat given out in the condensation of vapor into dew, he makes a minute examination into the quantity of dew that falls, and says,—"I conclude, therefore, that the heat evolved from the dew, or condensed vapor, that falls at night, is nearly if not quite sufficient to reduce the theoretical decrease of temperature due to radiation down to the amount which actually ob-

tains; and that the variations in the quantity of dew that falls at night, from one season to another, are attended with sufficient variations in the amount of heat imparted to the earth, to effect the changes observed in the nocturnal decrease of temperature during the year. I consider that in the average of months the amount of dew deposited from hour to hour during any one night, and from night to night, must increase steadily from sunset to sunrise, and from summer to winter. It follows from these conclusions that the probable cause of the secondary variations of the horizontal force is to be found in the varying quantities of dew deposited from one hour to another, and from one season to another." After some further remarks, Professor Norton shows that the actual effects of dew will, in particular cases, account for the variations observed between his theory and the results as at first found, or in other words, it will account for the discrepancies before referred to.

He next comes to the diurnal variations of the *vertical* magnetic intensity. The general theory is that the vertical intensity is proportional to the difference of temperature of two places situated at equal distances to the north and south of the station of the needle, and on a line perpendicular to the isogeothermal line. He finds that the actual state of things agrees at least approximately with his theory. There is, however, a slight discrepancy here also, for we find that the variations in the vertical intensity are generally less for the first and last than for the other two quarters of the year, while there is not an equal proportionate difference in the variations of temperature. This discrepancy is probably owing to this, that instead of taking the difference between the temperatures at the earth's surface, we should take the difference between the average temperatures of the stratum just below the surface, which is subject to a daily variation of temperature. This must be settled, however, by further investigation.

The last subject treated of is the diurnal variations of the *declination*. In this particular the general theory is, that the needle is nearly perpendicular to the isogeothermal line, that is, that the mean position of the needles is at right angles to the ideal line passing through those places which have the same mean annual temperature. This, Professor Norton considers to be also rendered probable by various facts which he states. He has some very correct remarks to the effect, that no theory should be rejected because, while it seems to accord with facts in all its important points, there are some minor discrepancies.

ON THE DIRECT PRODUCTION OF HEAT BY MAGNETISM.

AT the meeting of the Royal So iety of London, on the 24th of May, W. R. Grove, Esq., read an interesting paper "On the Direct Production of Heat by Magnetism." The author recites the experiments of Marrian, Beatson, Wertheim, and De la Rive, on the phenomenon which was discovered some years ago, that soft iron, when magnetized, emits a sound or musical note. He also mentions an experiment of his own where a tube was filled with the liquid in

h magnetic oxide had been prepared, and surrounded by a coil; exhibited to the spectator looking through it, an increase of the mitted light when the coil was electrized. All these experits, he considers, go to prove that, whenever magnetization takes , a change is produced in the molecular condition of the subes magnetized; and it occurred to him that, if this be the case, by a ies of molecular friction heat might be produced. In proving the ctness of these conjectures, many difficulties presented thems, the principal of which was, that with electro-magnets, the produced by the electrized coil surrounding them might be exd to mask any heat developed by the magnetism. This interferhe eliminated by surrounding the poles of an electro-magnet cisterns of water, and by this means, and by covering the keeper flannel and other expedients, he was enabled to produce, in a drical cast-iron keeper, when rapidly magnetized and demagneta rise of temperature several degrees beyond that which obtain the electro-magnet, and which therefore could not have been due ie radiation of heat from it. By filling the cisterns with water r than the electro-magnet, the latter could be cooled, while the er was being heated by magnetization. Subsequently, distinct nic effects were detected in a bar of soft iron, placed opposite to a ing permanent steel magnet. To separate the effects of magnetorical currents, the author then made experiments with non-mag metals and with silico-borate of lead, substituted for the iron ers, but no thermic effects were developed. He then tried the ietic metals, nickel and cobalt, and obtained thermic effects with in proportion to their magnetical intensity. The author then ludes by saying that he considers that these experiments prove whenever a bar of iron or other magnetic metal is magnetized, mperature is raised.—*Mechanic's Journal.*

ON THE POLARIZATION OF HEAT.

IE polarization of heat, first announced by Bérard, has been lished by various experiments by Forbes and Melloni. Provostand Desains have lately announced to the Academy of Sciences, 'aris, new investigations, showing,—1st. That heat, traversing nd spar, is divided into two pencils, completely polarized in the of the principal section or a perpendicular plane. 2d. That the ascertained by Malus, according to which the intensity of a ray letely polarized is divided between the ordinary and extraordiimages to which it gives origin in traversing the spar, is applito heat as well as light. 3d. That the variations of intensity h polarized heat experiences in its reflection from glass at differincidences, are exactly represented by Fresnel's formulas deterd for light, only allowing that the solar heat traversing the prism a little different index, 1.5. 4th. That there is a most perfect spondence between the phenomena presented in the reflection polished metals of polarized heat and polarized light.

THE PHENOMENA OF THE DAGUERREOTYPE PROCESS.

M. CLAUDET has communicated to the British Association a paper "On Researches on the Theory of the principal Phenomena of Photography in the Daguerreotype Process." Light produces two different effects on the Daguerreotype plate, capable of giving an image. By one, the surface is decomposed, and the silver is precipitated as a white powder; this action is very slow. By the other, the parts affected by light receive an affinity for the mercurial vapor, and this metal is deposited in white crystals. This action, which is the cause of the Daguerreotype image, is 3,000 times more rapid than the former. The two cannot proceed from the same cause. The first is a chemical decomposition of the surface, while the second is a new property imparted to the surface to attract the vapor of mercury, which is given by some rays and withdrawn by others, the most refrangible rays being the ones which produce the affinity for mercury. M. Claudet has so improved his photographometer that he can compose upon the same plate a series of intensities in a geometrical progression, varying from 1 to 512, or by employing two plates at the same moment, from 1 to 8,192. He is also enabled to study the modifications produced on various intensities of effect by the radiation of half the light, through various colored glasses. M. Claudet has ascertained one remarkable and inexplicable fact, that the two foci for the same distance of an object sometimes coincide and sometimes vary very far from one another; and the difference varies according to some unknown properties of the lenses, so that while the foci correspond in some lenses, they may be separated in others.—*London Athenæum, Sept.*

COLORED PHOTOGRAPHS.

THE *Comptes Rendus*, of the 12th February, contains the report of M. Biot and others, on the process discovered by M. Becquerel, of making photographic copies of colored objects with distinct impressions of the colors on the body so copied. The prospect, however remote at present, of being able to copy Nature in all the truth of color, gives great interest to every experiment which leads to an advance in this particular. The main features of the new process are the following. The ordinary silver plate, well polished, is connected with the positive pole of a battery of two series, and then plunged into a large vessel containing diluted hydrochloric acid. In the same fluid is placed a third plate of platina, which communicates with the negative of the battery. This plate is brought very rapidly a short distance from and parallel to the other. Under these conditions, the plate assumes successively the colors of thin films; at first a gray, then a yellow and violet tint, which passes soon to a blue and to a green, and becomes afterwards rose-colored, then violet, and at last blue. The operation must be stopped as soon as a lilac tint appears, and the plate withdrawn rapidly from the bath, washed with distilled water, and being placed in an inclined position, dried over a

spirit-lamp. The plates thus prepared may be preserved in the dark for a long time. In diffused light, the surface of chloride of silver, thus prepared, becomes gray; but if we project a very pure and concentrated prismatic spectrum, it receives, at different rates, impressions from all the visible luminous rays in their respective colors, at the same time that very decided colors are produced by the non-luminous rays below the red and beyond the violet. By warming the prepared plate some curious changes are produced; and if warmed on a stove to about 212° Fahrenheit, M. Becquerel states that the most perfect condition for imprinting the spectral colors is brought about. The time which the plate should be exposed to the solar spectrum varies with its intensity; when very concentrated, in a few minutes a finely colored impression is obtained. These photographic images may be preserved for a considerable time in the dark; but as yet no means have been discovered by which they can be rendered permanent against the continued action of light.

Admiring the zeal with which M. Becquerel has pursued his researches on this curious subject, we must not forget that Sir John Herschel has also succeeded in obtaining a colored impression of the spectrum, on paper prepared with vegetable juice; and that Mr. R. Hunt got a similar result with fluoride of silver. We may, therefore, reasonably hope that eventually the pencil of the sunbeam will add the charm of color to the chemical pictures it produces.—*London Athenæum.*

LUNAR DAGUERREOTYPES.

The existence of actinism, or the chemical principle of light, in the rays reflected from the moon's surface, has heretofore been a question of considerable doubt and uncertainty. At a meeting of the British Association, at Cork, some years since, Dr. Robinson stated, "that he had been led by the success of Professor Rondoni of Rome, in procuring Daguerreotype images of various fixed stars and nebulæ by means of light transmitted from these objects, to endeavour to procure a Daguerreotype impression of the moon's surface. A portion of the disk of the moon was brought within the range of a powerful reflecting telescope, and the brilliant image formed thrown upon a Daguerreotype plate placed in the focus of the reflector. The plate was left exposed in this situation for twenty minutes. Although a good impression of a building could be procured upon plates similarly prepared, in a minute, yet this prolonged exposure to the light of the moon produced no impression." Dr. Robinson considered the experiment as conclusive in establishing the fact, that the chemically active principle known as actinism did not exist in lunar light. Results similar to those of Dr. Robinson, have been also arrived at by various philosophers in Europe and America. Dr. Draper, of New York, however, has stated that he has been able to detect the actinic element both in moonlight and artificial light.

At a meeting of the Cambridge Scientific Association, December, 1849, five Daguerreotype pictures of the moon's surface were exhibited to the Society by Mr. Wells. These pictures were taken by Mr.

S. D. Humphrey, of Canandaigua, N. Y., with a half-size American camera, on a medium plate. The first picture was obtained by an exposure of two minutes, the camera remaining permanent. During this short interval, the earth had moved forward so rapidly, that the figure of the satellite was elongated to form an oval, or egg-shape picture. The same peculiarity was also noticed in the pictures obtained by an exposure for one minute, and also for thirty seconds, though in a less degree. In these pictures, the configurations upon the moon's surface were not delineated, but in the fourth picture, obtained by an exposure of three seconds, the representation was strikingly clear and distinct. The figure was round, and the representation of the surface so perfect, that its appearance, when examined under the microscope, somewhat resembled the full moon seen through a telescope. The fifth picture was obtained by an exposure of only half a second, and was little more than a shadow. The powerful agency and presence of the chemical principle was sufficiently indicated by it. These several pictures were all taken upon one occasion, on the night of the 1st of September, a few hours before full moon. They conclusively show that lunar light possesses the chemical principle or force, in a high degree, and it is to this source that we may reasonably attribute its supposed action in producing phosphorescence and other changes in animal or vegetable substances.—*Editors.*

PICTURES ON GLASS.

At a late meeting of the French Academy M. Evrard communicated the details of a process he has discovered, by which pictures can be taken upon glass. The principle of the discovery is a matrix of albumen, rendered sensitive to the action of light by aceto-nitrate of silver, and spread in a thin layer upon a plate of glass. The process is to take a certain number of the whites of eggs, and remove all the non-transparent part, and then add a few drops of a saturated solution of iodate of potassium, then beat the eggs into a froth, and allow the whole to settle. The plate of glass must be well cleaned with alcohol, and the albumen is then spread over it, in a thin layer, with another piece of glass. It is important that the glass should have a perfect, thin coat adhering to it, and to obtain this it must next be hung up by one of the corners, so that the excess may drain off, after which it should be placed to dry upon a level board, and screened from the dust. Then the glass is dipped into a solution of aceto-nitrate of silver, face downwards, after which it is stirred about in a basin of clean water for a few seconds, and is then completely sensitive to receive photographic impressions, either when it is moist or dry. It is then placed in the camera-obscura, after which it is dipped for a short time into a bath of gallic acid, in which there is a little of the nitrate of silver. Finally, it is washed in water, and having been immersed in a solution of bromide of potassium, it is again washed, and left to dry in a horizontal position in a dark room.

THE PHOTOGRAPHOMETER.

At a late meeting of the Paris Academy of Sciences, M. Claudet communicated a description of his newly invented instrument, for indicating to the photographer the intensity of the chemical rays, and at the same time the sensitiveness of his preparation. The apparatus is very simple, and serves equally for processes on paper and on metallic plates. It indicates the intensity of the chemical rays at all times of the day during atmospheric variations, and at the instant we may wish to operate. It serves also to compare the degree of sensitiveness of the different photographic preparations. It is necessary that an instrument of this kind should have a uniform motion without intricate machinery, and this is obtained by a means founded upon the principle of bodies sliding down an inclined plane. The sensitive surface is exposed to the light by the rapid and uniform passage of a metal plate, having openings of different lengths which follow a geometric progression. It is evident that the exposure to the light will be the same for each experiment, because the plate falls always with the same rapidity, the height of the fall being constant, and the angle of the plane always the same. The photogenic surface, whether it be the Daguerreotype plate, the Talbotype paper, or any other sensitive preparation, is placed near the bottom of the inclined plane, and is covered with a thin plate of metal pierced with circular holes, which correspond to the openings of the moveable plate. By placing beneath each series of holes a different sensitive surface, each of these will receive the same proportion of the same light, and thus the different degrees of sensitiveness may be compared. It is indispensable, in making an exact comparison, to operate with the same light and during the same space of time, as it is known that the light varies from one minute to another; this is accomplished by the photographometer. M. Claudet announces that this apparatus has furnished him with a very extraordinary fact, which, however, he does not give as precisely correct; but he thinks that he cannot be far from the truth in stating, that the pure light of the sun modifies the bromo-iodized silver plate, communicating to it an affinity for mercurial vapor, which produces the white image in the Daguerreotype, in about the thousandth part of a second. He made the experiment by admitting the light of the sun through an opening of a French millimetre in size, and this opening passed over a space of 350 millimetres in a quarter of a second, so that the light could not have acted on the plate more than the thousandth part of a second. It is suggested that this instrument may be used to ascertain the effect of the compound light, and that of the different separated rays of the solar spectrum; how much photogenic light is lost by reflection from parallel mirrors, prisms, and other substances, and by refraction through lenses; the proportion of photogenic rays in the light obtained from various sources, including that produced by electricity; if the photogenic light varies with the height of the atmosphere and with the changes of temperature, and if it is affected by the electrical state of the atmosphere; and, lastly, what is the proportion of the photogenic rays at each hour of the day, and at different points in space at a given moment.

ON SOME NEW PHENOMENA OF LIGHT AND ACTINISM.

THE following is an abstract of a paper recently presented to the Royal Society by Robert Hunt, Esq. The chemical change produced in chloride of silver when exposed to the action of the sun's rays, by which powerful chemical affinity is broken up, chlorine liberated, and silver in a state of fine division left, was selected as an exemplification of the actinic force, which was the subject of consideration. This chemical change takes place in white light, and hence all those photographic phenomena which have created so much interest have been referred to luminous power. If, however. we examine the conditions of light as analyzed by the prism,—presenting, not seven colored bands, as stated by Sir Isaac Newton, but nine as proved by recent experiments,—it is found that these colored bands possess opposite properties. For instance, the chloride of silver will not darken in the mean luminous ray of the spectrum, nor will it darken either at the end which gives the greatest calorific effect, or at the end which is embraced by the lavender ray, usually regarded as representing the most chemically active part; consequently we find three points in the spectrum which will not produce any change in chloride of silver. Where we have the most light, and at two extremities where the light ceases to affect the human eye, and also laterally, bands are exhibited which show the same physical conditions, and thus it would appear that the *circle of light* is not the agent producing this peculiar alteration. Regarding, as appears natural, the ordinary prismatic spectrum as the representation actually of two spectra consisting of but three colors,—red, blue, and yellow, which is shown by the reappearance of red light in the blue and of yellow light in the lavender ray, which blue light appears again at the least refrangible end in the extreme red or crimson ray,—we have an explanation of the result above mentioned, and the want of chemical action is shown to arise from the operation, indeed, of the most luminous bands. By absorbent media, as colored glasses and fluids, these results were more fully explained. The most remarkable results have, however, been lately obtained by the use of colored media; and it has been shown that every luminous ray, independent of color, may be made to protect chloride of silver from that chemical change which is induced by the direct action of diffused daylight,—the portion upon which those rays fall being actually preserved as a white space, every other part being blackened. It was contended that no hypothesis of interference would explain this result, which more decidedly proved than had hitherto been done, the wide difference between the phenomena of light and actinism. The fact that luminous effect—phosphorescence—was produced by the blue rays of the spectrum, appears to oppose this view; but when we find that, in like manner, electricity was interrupted, it appears more rational to refer phosphorescent phenomena to some peculiar electric excitation. The action of the solar rays on the developement of vegetable life was then explained, and the following conclusions suggested as the explanation of experimental results frequently repeated;—1. *Germination*, which will take place in the

dark, is quickened by the actinic force, and retarded and often stopped by the luminous power. 2. *Lignification.* The decomposition of carbonic acid by the plant is due to some excitement of luminous power, and is stopped by the actinic force. 3. *Formation of Chlorophyll.* Due entirely to the luminous rays. 4. *Flowering and Fruiting.* Dependent upon the action of the thermic or parathermic rays of the spectrum, as distinguished from both the luminous and actinic forces. 5. *Motion of Plants.* Bending to the blue light, and receding from the red, proving the excitement of actinic force.—*London Athenæum, April.*

THE VELOCITY OF LIGHT PROVED BY ACTUAL EXPERIMENT.

It is well known that the proof of the enormous velocity of light, amounting to 192,000 miles per second, has hitherto been derived only from the observations and calculations of astronomers and geometricians, and that this velocity has never been demonstrated by any experiment. In 1675 Roemer first announced the extraordinary velocity of light, which he had derived from observations on the satellites of Jupiter, and in 1728 Bradley was led to the same result by studying the phenomena known as "the aberration of light." Since the same result was thus arrived at in two totally different ways, there could be no doubt of the fact; but still scientific men have long desired to render it more evident by actual experiment. This has at last been accomplished by a French *savan*, M. Hippolyte Fizeau, from whose communication to the French Academy, on July 23d, we make the following extracts. "I have succeeded in demonstrating the velocity of light by a method which seems to me to furnish a new means of studying with precision this important phenomenon; this method is founded on these principles. When a disk turns in its plane with great rapidity around its centre of figure, it is possible to estimate the time occupied by a point in the circumference in describing a very small angular space, a thousandth of the circumference for example. If the rapidity of rotation is great enough, this time is very short, being for ten or a hundred revolutions per second only one ten-thousandth or one hundred-thousandth of a second. If the circumference of the disk is divided, like a toothed wheel, into equal intervals, alternately open and closed, the time occupied by the passage of each of these intervals through the same point of space will be the same small fractions. During so short periods the light passes over quite limited spaces, being 31 kilometres (19.5 miles) for the first fraction, and 3 kilometres (2 miles) for the second. If a ray of light which has passed through one of the divisions of the wheel is reflected from a mirror placed at a certain distance, and returns to the same point, the time occupied in the propagation of this ray must necessarily intervene, and the ray at its return will pass through an open space in the wheel, or will be stopped by a closed one, according to the rapidity of the motion of the wheel and the distance from which the light is reflected.

"A *system of two telescopes* directed towards each other, so that the

image of the object-glass of each is formed in the focus of the other, furnishes us, in a very simple manner, with the essential condition of a ray of light, which, starting from a point, is reflected at a certain distance so as to return to its starting-point. For this all that is necessary is to place in the first telescope, between the focus and the eye-glass, a transparent glass at an angle of 45 degrees, which sends towards the object-glass the light received obliquely from a lamp or from the sun; and also to place a mirror in the focus of the object-glass of the second telescope. This arrangement answers perfectly, even when the telescopes are separated to a considerable distance. With telescopes of an aperture of 6 centimetres (2.5 inches) the distance may be 8 kilometres (5 miles) without weakening the light too much. We then see a luminous point like a star, formed by the ray of light, which, starting from the focus of the first telescope, and being reflected by the inclined glass through a space of 16 kilometres (10 miles), returns exactly to the same point of departure, traverses the same plate of glass, and finally enters the eye.

"It is through the point of departure that the teeth of the revolving disk must be passed to produce the effects indicated. The experiment is made without any trouble, and the least practised eye perceives immediately that, according to the greater or less rapidity of the motion, the point of light shines brightly or is wholly eclipsed, as it meets an open or closed space. Under the circumstances in which I made the experiment, the first eclipse took place when the disk was revolving at the rate of about twelve revolutions and six tenths per second. With a double rapidity the point again shone out, was eclipsed with a triple rapidity, reappeared with a quadruple one, and so on. The first telescope was placed in the cupola of a house situated at Suresnes, and the second one upon the heights of Montmartre at the approximate distance of 8,633 metres. The disk, having on it 720 teeth, was mounted on wheel-work moved by weights; a scale furnished the means of measuring the rapidity of the rotation. The light came from a lamp so arranged as to furnish a very brilliant light."

If we correctly understand the meaning of M. Fizeau, it is evident, in the first place, that the distance of the telescopes, the rapidity of the rotation, and the interval of time which separates the passage of an open from that of a closed space, are known; secondly, that the meeting of a ray of light with an open or closed space, and consequently its reappearance or its eclipse when it has been reflected back after having passed over the double space of 8,633 metres, depends solely upon this distance and upon the velocity with which it has been transmitted, and upon the rapidity with which the disk revolves. Finally, it follows that the only unknown quantity in the problem, the velocity of the ray of light, is deduced at once from the two other quantities previously known, namely, the distance passed over and the rapidity of the motion of the disk, joined to the easy observation of the reappearance or the eclipse.

The repeated experiments made in this manner by M. Fizeau give him for the velocity of light a value differing very little from that as-

signed by astronomers. The extraordinary agreement of the results obtained in the three ways, from observation on the eclipses of the satellites of Jupiter, from the phenomena of aberration, and from actual experiment, leaves no doubt that light does really travel with the enormous velocity of about 192,000 miles per second.

Soon after the above announcement was made by M. Fizeau, he received the cross of the Legion of Honor, as a reward for his ingenuity.

NEW OPTICAL INSTRUMENT.

Professor John Locke has invented a curious instrument, named by him Phantascope, which will illustrate, in a manner never before accomplished, "single vision by each eye." It is very simple, and has neither lenses, prisms, nor reflectors. It consists of a flat board base, about nine by eleven inches, with two upright rods, one at each end, a horizontal strip connecting the upper ends of the uprights, and a screen or diaphragm, nearly as large as the base, interposed between the top strip and the tabular base, this screen being adjustable to any intermediate height. The top strip has a slit one fourth of an inch wide and about three inches long from left to right. The observer places his eyes over this slit, looking downward. The movable screen has also a slit of the same length, but about an inch wide. There are two identical pictures of a flower, about one inch in diameter, placed the one to the left and the other to the right of the centre of the tabular base, or board forming the support, and about two and a half or three inches apart from centre to centre. A flower-pot or vase is painted on the upper screen, at the centre of it as regards right and left, and with its top even with the lower edge of the open slit. By looking downward through the upper slit, and directing both eyes steadily to a mark,—a quasi stem, in the flower-pot or vase,—instantly a flower similar to one of those on the lower screen, but of half the size, will appear growing out of the vase, and in the open slit of the movable screen. On directing the attention through the upper screen to the base, this phantom flower disappears, and only the two pictures on each side of the place of the phantom remain. The phantom itself consists of the two images painted on the base, optically superimposed on each other. If one of these images be red and the other blue, the phantom will be purple. If two identical figures of persons be placed at the proper positions on the lower screen, and the upper screen be gradually slid up from its lowest point, the eye being directed to the index, each image will at first be doubled, and will gradually recede, there being of course four in view until the two contiguous coincide, when three only are seen. This is the proper point where the middle or double image is the phantom seen in the air. If the screen be raised higher, then the middle images pass by each other, and again four are seen, receding more and more as the screen is raised. As all this is the effect of crossing the axes of the eyes, it follows that a person with only one perfect eye cannot make the experiments. They depend on *binocular vision*.

All these effects depend on the principle, that one of the two primitive pictures is seen by one eye, and the other by the other eye, and that the axes are so converged by looking at the index or mark on the upper screen, that those separate images fall on the points in the eye which produce single vision. To a person who has perfect voluntary control over the axes of his eyes, the upper screen and index are unnecessary. Such an observer can at any time look two contiguous persons into one, or superimpose the image of one upon the image of the other.

We find in a letter from Professor Locke one or two additional experiments described. He says:—"I took the figure or picture of a person about two inches in height, and, having cut its outline from the paper, and cut off the head, I placed the body to the left on the lower screen, and the head to the right on a level with its proper position, and directed my eyes to the index of the movable screen, when the body appeared to move in from the left and the head from the right till they were apparently reunited, and an entire figure presented itself to view. But, from a little unsteadiness of the eye in a forced position, the head had a small motion, sometimes reaching forward in the attitude of earnestness, then drawing back with an expression of dignity. I found, too, that my eyes were not always mates. At one time the body, which was seen by the right eye, appeared bright, while the head, seen by the other eye, was dim and confused. After a little these conditions were reversed, and the left eye gave the brighter image. When the images of two colored objects are optically superimposed by the phantascope, say a blue and red wafer, the phantom will sometimes be purple, again it will be red, when, on reversing it, the blue will predominate; showing that one eye is more sensitive to colors than the other, and that the double-imaged phantom will appear of that color which falls on the stronger eye. Throwing aside the machinery of the phantascope, I crossed the axes of my eyes, and looked at the window of my room, increasing the convergence until the two images of the window lay side by side, the right-hand side of one image lying along the left-hand side of the other. These edges did not appear to be parallel, the lower ends being apart while the upper ends were in apparent contact. From this it appears that the eyes did not rotate in the same horizontal plane. On throwing the head back as far as possible, and making the same convergence of the axes, the perpendicular objects preserved their parallelism, and the two sides of the two images of the window coincided throughout. Whether this is true of the eyes of all persons is doubtful. These experiments on binocular vision are not so amusing as several others in optics, and to some persons the effort to distort the optical axes is painful, like looking at a double impression in printing. The struggle between the knowledge of where the primitive picture really is, and the optical impression of the phantom, is sometimes quite painful; but, as soon as the imagination realizes the place of the phantom, it is contemplated with as much ease as a real object. There is a mathematical ratio in the several quantities concerned. For example, the distance from the eye to the phantom is to the distance from the

phantom to the object, as the distance between the eyes is to the distance between the identical pictures converged together. It follows, that, any three of the quantities being given, the fourth can be calculated either by proportion or by equation. By this means I calculated the diameter of the floor-cloth panels, the result being within one fourth of an inch of the actual measurement. I mention this merely as an illustration of the subject for the base line; the distance between the eyes is too short for practical use."

This instrument shows that we do not see an *object* in itself, but the mind contemplates an image on the retina, and always associates an object of such a figure, attitude, distance, and color, as will produce that image by rectilinear pencils of light. If this image on the retina can be produced without the object, as in the phantascope, then there is a perfect optical illusion, and an object is seen where it is not. Nay, more, the mind does not contemplate a mere luminous image, but that image produces an unknown physiological impression on the brain. It follows, that if the nerves can, by disease or by the force of imagination, take on this action, a palpable impression is made without either object or picture. As this would be most likely to occur when actual objects are excluded, as in the night, we have an explanation of the scenery of dreams, and the occasional "apparitions" to waking persons.

USE OF COLORED GLASSES TO ASSIST THE VIEW IN FOGS.

M. Luvini, of Turin, in a letter to the editor of *L'Institut*, at Paris, makes the following curious observation, which, if confirmed, may prove to be of great importance:—"When there is a fog between two corresponding stations, so that the one station can with difficulty be seen from the other, if the observer passes a colored glass between his eye and the eye-piece of his telescope, the effect of the fog is very sensibly diminished, so that frequently the signals from the other station can be very plainly perceived, when without the colored glass even the station itself is invisible. The different colors do not all produce this effect in the same degree, the red seeming to be the best. Those who have good sight prefer the dark red, while those who are short-sighted like the light red better. The explanation of this effect seems to depend upon the fact, that the white color of the fog strikes too powerfully upon the organ of sight, especially if the glass have a somewhat large field. But by the insertion of the colored glass, the intensity of the light is much diminished by the interception of a part of the rays, and the observer's eye is less wearied, and consequently distinguishes better the outlines of the object observed."

ON AN UNNOTICED KIND OF ABNORMAL VISION.

Professor C. Dewey communicates to *Silliman's Journal*, for November, the following notice of a new kind of abnormal vision. There are two well-known kinds of *abnormal* vision in eyes not dis-

eased, the *far-sighted* and the *near-sighted.* The former occurs in good eyes, as persons advance in life, beginning about the age of forty, and is remedied by *plane*, or, better, by *convex* spectacles. The latter is found in youth, or young persons, and finds its remedy in *concave* glasses. The far-sighted are unable to see near and small objects, and remove them to an inconvenient distance, while they see remoter objects perfectly well without glasses. The near-sighted are unable to see small objects unless they are brought inconveniently near, and they have no distinct vision of remote objects. There is a kind of abnormal vision, different from either of these, which is not far-sighted nor near-sighted, but in which near small objects, or larger distant objects, are not seen with distinctness. This imperfection occurs in children and young persons, and is remedied by *convex* spectacles which are suited to the eyes of persons from sixty-five to seventy years of age. The *younger* eyes require the *older* glasses, and with advanced years *less convex* glasses are required. At the age of forty-five or more, this kind of abnormal vision becomes much diminished. As the young use the glasses of the far-sighted, this kind may be called *neo-macropia.* It is evident that *convex glasses produce that change in the rays of light which fits such eyes to see distinctly small and large objects at varying distances.* This fact proves that there is no defect in the *adjusting power* of the eyes. The cause, then, is to be sought in the *structure* of the eye. As this kind of eyes does not appear to be too much or too little convex, and as the image is not formed soon enough in the eye, or is too far back, either or all of the three following may be the cause:—1st, too little convexity of the crystalline lens; or, 2d, its position too near the retina; or, 3d, its too little density. The second is the probable cause. Spectacles sufficiently convex would bring the rays to a focus, let either or all of the three causes operate, and with the usual adjusting power of the eye give distinct vision for near or remote objects. Though this kind of abnormal vision seems not to have attracted attention, for I have found but one allusion to it in consulting authors on optics, it is relatively common. In New England and New York, more than fifty instances of it have come to my knowledge in the five or six years past. A child of fifteen was able to see distinctly, for the first time, by the use of his grandfather's spectacles. A young man of eighteen required convex glasses of ten-inch focus, while persons of seventy years use those of fourteen to eighteen inch focus. Children often make little progress in study, because they do not see objects distinctly, though the defect is not suspected by them, and is utterly unknown to parents and teachers. The knowledge of this subject will make spectacles a still greater benefit to our race.

PHYSIOLOGICAL ACOUSTICS.

In order to ascertain the causes of the same body communicating to our ear different tones at the same time, M. Duhamel has made the following experiment. A caoutchouc thread connected consecutively with different points of an oscillating plate, producing simultaneously

two or three notes, was conveyed to one ear, while the other was stopped. He convinced himself that an impression of sound could arrive at the ear in this manner only, and yet all the notes were audible at the same time at all the different points. Hence Duhamel concludes, that if the oscillatory motion of one point be decomposed into several others, the ear is affected in the same manner, whether the component movements emanate simultaneously from several neighbouring points, or from one point only.—*Liebig's Annual Report.*

MIRAGE ON LAKE SUPERIOR.

DR. CHARLES T. JACKSON communicated to the American Scientific Association, during its session at Cambridge, an interesting paper entitled "Observations on the Mirage seen on Lake Superior in July and August, 1847."

"The phenomena of mirage have at all times excited the wonder and admiration of mankind, and have been fruitful in strange superstitious legends. Even those most versed in the causes of natural phenomena cannot fail to be strongly impressed with the magnificent phenomena of mirage on the north shore of Lake Superior, and the philosophical mind delights in being able there to observe the causes which produce this marvellous effect. I know not whether the season when I had the opportunity for making my observations was one remarkable for the frequency of mirage, but it is certain that, for many successive days, the phenomena were presenting themselves in rapid succession along the northern coast of Lake Superior, opposite to Isle Royale, and on the coast of the island itself, in the bays which so deeply indent its shores. At Rock Harbour, on several occasions, I observed the little islands and points on its outskirts most perfectly represented, with inverted pictures of their entire forms hanging over their summits, the images of the spruce and other trees which crown them being seen with beautiful distinctness directly over their terrestrial originals, while the picture of a little skiff was one day seen represented beside the phantom island, the boatman in the sky appearing to raw his *batteau* as unconcernedly as his original on the bosom of the Lake.

"On the 27th of July we saw Keweenaw Point in mirage. It is 40 miles distant from this place, and bears E. N. E. from Scovil's Point on Isle Royale. The most wonderful mirage was observed from the north coast of Isle Royale, while we were coasting along from the eastern to the western end of the island. For several days in succession, we had almost hourly magnificent repetitions of these curious phenomena. Thunder Cape, 15 miles distant to the north, a lofty mural precipice, said to be 1,300 feet high, and rising directly from the lake, presents the form of an irregular truncated pyramid. By the phenomena of mirage it suddenly changes its form into a huge anvil, sending out a long horn to the right, while a dark black mass rises behind it which might be represented as old Vulcan himself. This singular phenomenon attracted much attention, and on observing with care, I found that the horn of the anvil was the image of the

talus of the cliff on the shore, represented in inverted picture. The image seen at the summit was probably that of a conical peak in the rear of the cliff, represented inverted over the Cape. Turning away from this phantom for a while, when we looked again the anvil-horn had been removed, and the figure over it was gone; but it soon reappeared as before, and for several days we were gratified with a view of these singular and interesting appearances, which seemed like the changes of the magic-lantern. Occasional rumblings of distant thunder came to us from afar, though no storm visited us.

"Not among the least curious and important refractions are those produced on the rays from the celestial bodies. At times the sun yields to the strange refractions, produced by the atmosphere over this great lake, and as he draws near to the horizon expands his broad cheeks most good-naturedly, or sends out a long pear-shaped neck towards the horizon. Dr. John Locke took many sketches of the remarkable forms assumed by the sun, and will probably give some account of his observations. The afternoon observations for a time were found to be much affected by the unusual refractions of the atmosphere of the lake, and evening observations of the stars were found to be utterly useless. Only stars of very high altitude, such as could not be reached by the sextant with an artificial horizon, can be employed for determination of latitude and longitude. This was proved by numerous trials. The morning observations were found to be more reliable, and were exclusively used in our determinations of longitude. It is probable that this extraordinary refraction is limited to the vicinity of the lake. It may be worth while to endeavour to explain the curious phenomena which I have described, and to account for the strange antics performed by the woodland scenery of the lake coast, and of the inverted image of the fisherman's boat as observed.

"Lake Superior, being an inland ocean of fresh water in a high northern latitude, (between 46° and 49° north,) has a nearly uniform and constant temperature, probably not far from the mean temperature of the climate. It ranges from 37° to 42° Fahrenheit, never rising above the latter temperature excepting in shallow places near shore. The average depth of the lake is estimated by Bayfield at 900 feet. Its height above the sea is 600 feet; hence its bottom is 300 feet below sea level. The shores of this lake are much more elevated than those of the other great lakes, and high table-lands extend far back into the interior, and are thickly wooded. The coast, especially on the north side of the lake, is abruptly precipitous directly to the water's edge; and the air on the surface of the lake rarely is of a higher temperature than 50°, while that in the forest at noon is frequently as high as 90°, or even 94°. It is obvious, then, that during a summer's day the air in the forests becomes highly rarefied by heat, and takes up a proportional quantity of water in the state of invisible moisture. When this current of warm air slides from the precipices, over the surface of the lake, the warm air by its specific levity from rarefaction floats upon the cooler air of the lake, and does not directly mingle with it. The consequence necessarily is, that a *film of moisture* is condensed at the surfaces of contact

of the warm and cold air, and thus a screen is produced on which the objects reflected from below are seen as in a mirror. Meanwhile, by refraction, this image is seen higher up than it is really painted on the mist. This was obviously the cause of the strange phantoms which we have witnessed on Lake Superior. It is no uncommon thing on other parts of the Lake to see vessels inverted in the air before their hulls become visible above the horizon; and it is well known that similar appearances *very rarely* occur on our sea-coast, and have given rise, in former times, to strange and superstitious tales."

Prof. Agassiz mentioned an additional phenomenon, which was frequently witnessed by himself and his party upon Lake Superior. Not only did the shores and islands, with all their vegetation, appear repeated, higher up and in an inverted position, but above this inverted landscape there was sometimes still another, in which every thing was upright, so that the picture was twice repeated above the surface of real nature,—once inverted, and above that, the same erect. This fact must be explained by any theory which professes to account for similar phenomena; but it may be simply the image of the landscape, inverted upon the surface of the lake, reproduced with the inverted image of the landscape itself.

HEAT AND EVAPORATION OF THE EARTH.

At a recent meeting of the Geographical Society of Bombay, Mr. G. Buist made an interesting communication on a method adopted by him for ascertaining the heat of, and evaporation from, the soil. The objects and details of the experiment are stated to be as follows:— "As the evaporation from a shallow dish of water exposed to the sun, and liable to be raised to a temperature of 100°, or 120°, gives no idea of the amount of evaporation from the surface of the sea, large pools, or lakes, which vary very little in temperature, he was anxious to determine the amount of evaporation from the surface of wet earth, compared with that from the surface of a considerable mass of water. With this view, two zinc cylinders were prepared, three feet long and four inches in diameter, and secured by a strong brass ring, at the top and bottom, carefully turned. These contained fifteen pounds, or a gallon and a half of water, each, temperature 82°, or nineteen pounds of the loose red earth to be found associated with trap-rock. When filled with earth well shaken down, they were able to take in six and a half pounds of water to overflowing. Each was provided with a glass tube, of a quarter of an inch bore, connected with the bottom of a cylinder, and running parallel with it, to the top; this was intended to show how high the water stood inside. On filling one of them with earth, and then adding water till it flowed over, that in the tube decreased of course rapidly by evaporation,— but, strange to tell, after continuing to descend from noon till day-break, it commenced immediately to rise again till 11 A. M., remained motionless till 1 P. M., when it began to sink, and so continued descending, till about an hour after sunrise, when it commenced immediately to rise, and so continued till the same hour as during the

preceding day. This had gone on regularly for four days; each day it sank from two to three inches, and only rose half as much; the fluctuation was in all respects most perfectly regular and symmetrical."—*London Athenæum, Sept.*

NATURE OF THE CANDLE-FLAME.

M. VOLGER has recently subjected the flame of the candle to a new analysis. He finds that the so-called *flame-bud*, a globular blue flammule, is first produced at the summit of the wick; this is the result of the combustion of carbonic oxide, hydrogen, and carbon, and is surrounded by a reddish violet halo, the *veil*. The increased heat now gives rise to the actual flame, which shoots forth from the expanding bud, and is then surrounded at its inferior portion only by the latter. The interior consists of a dark gaseous cone containing the immediate products of the decomposition of the fatty acids, and surrounded by another dark hollow cone, the *inner cap*. Here we already meet with carbon and hydrogen, which have resulted from the process of decomposition, and we distinguish this cone from the inner one by its yielding soot. The *external cap* constitutes the most luminous portion of the flame, in which the hydrogen is consumed, and the carbon rendered incandescent. The surrounding portion is but slightly luminous, deposits no soot, and in it the carbon and hydrogen are consumed.—*Liebig's Annual Report.*

ARTIFICIAL MOTHER-OF-PEARL.

ON the library-table were several curious and beautiful specimens of De la Rue's application of Sir Isaac Newton's thin plates,—carved wood, embossed card, plaster of Paris, paper, &c.,—presenting a metallic appearance, but likewise splendid iridal colors, the green predominant. The paper was cut into the form of birds, beetles, &c.; the varying green shield of the beetle was most natural, and evinced the power of producing any tint or effect required. The material employed for coating the above substances is a colorless varnish, applied by being dropped on water, the specimen to be coated, previously placed in the water, being lifted up against the thin film into which the drop had spread. The colors are due, of course, to the interference of the luminous rays,—the light reflected from the upper interfering with that reflected from the under surface; and upon the extent of the retardation of the luminous waves by such interference, the varieties of colors depend. Mother of-pearl affects light similarly, and thence its lovely hues. White paper, with Mr. De la Rue's coating of varnish, is artificial mother-of-pearl, and a most beautiful representation of it.—*Proceedings of the Royal Institution.*

THE FRICTION OF WATER.

MR. R. RAWSON has communicated to the British Association at Birmingham, a paper upon the friction of water, containing the result

of experiments made by him, their object being to ascertain the friction of the water on a vessel, or other floating body, rolling in it. In making his experiments, he used a cylindrical model, thirty inches long, and twenty-six inches in diameter, whose weight was two hundred and fifty-five pounds, avoirdupois. The cylinder was in the first place put into a cistern without water, and made to vibrate on knife edges passing through its axis. A pencil, projecting from the model, in the direction of the axis of the cylinder, on the surface of another movable cylinder, marked out, upon paper placed on this last cylinder, the amplitude, or extent, of each oscillation. The cylinder was deflected over to various angles, by means of a weight, attached by a string to the arm of a lever fixed to the cylindrical model. The table given by Mr. R. shows that in these cases the model vibrated to an angle, in general 6′ less than the angle to which it was deflected. When the cylinder oscillated in exactly the same circumstances, except that it was surrounded by salt water, it appears that the angle of vibration was about 30′ less than that of deflection. This shows clearly, that when vibrating in water there is a falling off in the angle of about 24′ from the vibration out of water. This decrease must be attributed to the friction of the water on the surface of the cylinder. The author thinks, from calculations, that the amount of force acting on the surface of the cylinder necessary to cause this decrease is not equally distributed over it, but that the amount on any particular part varies as the depth. Some experiments confirm this view. These, with other experiments, made under the direction of the Admiralty, go to show that when "a sudden gust of wind is applied to the sails of a vessel, or any cause which acts constantly during one oscillation, the ultimate amplitude of deflection will be double the amplitude which the gust of wind will permanently deflect the vessel."—*London Athenæum, Sept.*

LIEUT. MAURY ON WINDS AND CURRENTS.

Lieut. Maury is still pursuing his favorite theory of winds and currents, which has already been productive of much good to the commercial world, although the observations as yet made have been very limited compared with those which must be made before a correct knowledge can be obtained of the winds and currents of the different oceans. His "Wind and Current Charts" are so made, that at a single glance the navigator is able to see in what portion of the Atlantic Ocean he shall probably find the most favorable winds and currents. He has adopted the plan of dividing the ocean into sections of five degrees each, and the track of each vessel is laid down across it in colors according to the seasons of the year, and in characters according to the month, while the symbols for the winds are so contrived that they show at once both its direction and strength. In this way the charts show at a glance the prevailing winds, the temperature of the water, the set and velocity of the currents, the variation of the compass, &c. The results gained by these charts are numerous; we give the most important of them.

It has been discovered that the trade-winds in the North Atlantic blow with more regularity on the American than on the African side of the Atlantic, owing, probably, to the fact that in the latter case the sands and deserts, which heat and rarefy the air, are to the windward, while in the former they are to the leeward. It is also shown that the so-called northeast trade-winds prevail more from the northward on the American than they do on the African side of the ocean, and that calms are much less frequent on this than on that side of the ocean.

After carefully comparing the log-books of many thousand vessels sailing between the United States and Brazil, China, the Indies, the Cape of Good Hope, and Cape Horn, the author of these charts has been led to the important discovery that the circuitous course usually taken to these places may be avoided. It may here be remarked that the usual route of vessels bound from our Atlantic coast to the parts of the world named is nearly the same until they reach the equator. But these charts indicate an entirely new route thither. The usual course of our vessels bound to Rio Janeiro, or the Cape of Good Hope, is across the Atlantic Ocean to the shores of Africa, thence to the coast of Brazil, and, if bound to the Cape, a third time across the ocean. This zigzag course has been hitherto pursued, in the belief that, in following it, better winds have been found than if any other had been taken. The facts derived from the log-books and records of a thousand ships show this belief to be unfounded.

It has been made to appear that monsoons, or trade-winds, prevail in that part of the Atlantic through which a part of the old route to the equator lies, where no such winds have been thought to exist. From June to November, inclusive, these winds prevail from the southward and westward. And they are exactly in that part of the ocean where, strange though it may appear, vessels, ever since the days of Cook and Cavendish, have been in the habit of going, with the expectation of finding winds favorable for a course to the southward and westward.

In consequence of results like these, Lieut. Maury was led to examine the materials his industry had accumulated, in order to find a better route. Accordingly, one was discovered and announced, which, besides being several hundred miles nearer, lies also through a region of more favorable winds; insomuch that the average passage of a number of vessels which have tried this new route during the last year is ten days, or about 25 per cent., less than the average by the usual course to the equator.

In consequence of his investigations, Lieut. Maury was induced to recommend a more northerly route than the one usually taken by vessels in the European trade. The ship Wisconsin followed this recommendation on her voyage from Liverpool to New York with great success. She arrived at her port of destination twelve days before two other ships which sailed in company, but which went farther to the south. It is not claimed that such a difference will invariably occur in the length of passage by the two routes, but the result is *nevertheless* full of significance, and indicates the great importance

and value to be attached to the subject. If the voyage across the Atlantic can be shortened but a day or two, commerce will still reap important benefits.

A still further examination of the materials at his command, has led Lieut. Maury to other promising results. By projecting the courses of large numbers of vessels engaged in the trade of the Gulf of Mexico and noting the currents they have met with, it has been made to appear more than probable that a current has been discovered, which (if found to exist) will shorten the usual sailing distance from Havana to New Orleans, and to other ports in the States bordering on the Gulf, nearly one third. By the route usually pursued, vessels have to encounter an opposing current, running at the rate of nearly sixty miles per day. It is believed that, by following along the Cuba shore, vessels bound to New Orleans will find a current in their favour of equal velocity.

In a letter to some citizens of New Bedford, Lieut. Maury enumerates some of his other results. He says that he has ascertained that "the northeast trade-winds form an atmospherical band in the North Atlantic, with surprising regularity of breadth. Were this band opaque, or were it visible to an astronomer in the moon, it would appear to him not unlike the belts of Jupiter do to us, but upon a scale greatly enlarged. Could it be seen by an observer in the moon, he could mark our seasons by it; so regularly do the materials already furnished show its vibrations up and down in latitude to be according to our months and seasons. This band of northeast trades is not, as has been supposed, parallel to the equator. It is parallel to the ecliptic. The manner in which these conclusions are arrived at admits of no more doubt as to these facts, than there is as to the existence of the trade-winds themselves."

Referring to the merchant-vessels, which have been supplied with his charts, he adds, "When these thousand ships return with their observations made simultaneously in all parts of the world, who can anticipate the value or the nature of the results to be obtained? When it is blowing a norther in the Gulf, or a tornado in the West Indies, for instance, these observations will enable us to see what it was doing on the other side, across the Isthmus of Tehuantepec. I am beginning to receive returns from this fleet. Our system of observations requires the water-thermometer to be used; and in consequence it is now beginning, for the first time, to be *generally* used in the merchant service. From the returns already received, this instrument indicates a fork in the Gulf Stream, on the banks of Newfoundland. It also indicates the existence of a cold current setting westwardly between two warm ones running towards the east; and it indicates, further, the probability of the Grand Banks extending nearly to the coast of Europe. This is all the thermometer can do in this respect; it can only indicate. Suppose—and the supposition is probably not far wrong—that the rate of this cold current and of each of these warm ones is one mile the hour; vessels do not know where the dividing line between them is. They lie in the track to Europe; and if we suppose the average time for which a vessel, on her passage to and fro, is exposed to them to be ten days, we shall see that each vessel

may be swept back or carried forward by the current to which she is exposed during that time, 240 miles; thus making a difference of 480 miles in her progress during only ten days of her passage, according as she may have the luck to strike the adverse or favorable current. Would it not be a great advantage to every vessel in the European trade, if she knew exactly where to find these currents, and where to go to avoid the adverse one, and where to take the favorable one? To ascertain their limits is more than individual enterprise can do,—it would require a vessel to be sent there for the purpose, and to employ several months in the examination; therefore this would seem to be the business of government.

"As for your favorite subject, the whales, I am happy to inform you that Lieut. Herndon has them already in hand; and though his investigations have not yet gone far enough to authorize conclusions, yet there is no doubt in my mind, that, if you will send us well-kept journals, and *enough* of them, we shall be able to construct a chart which will show at a glance in what part of the ocean the whales have been found in quantity in the different months; and we shall show the parts that are never frequented by them. Take, as an example: he has examined the logs of vessels which in the years 1833, '34, '35, '39, '40, '44, '45, and '46, cruised 429 days in the square from 5° N. to the equator, between the meridians of 80° and 85° W., and whales were found there in quantities in every month except January, February, and March. In the square from 5° N. to the equator, between the meridians of 90° and 95° W., he has in like manner examined the logs of vessels which cruised there in search of whales 190 days in the years 1832, '33, '34, '35, '36, '39, '40, '41, '43, '45, and '46. Some one of these vessels was there in every month of the year, except December; and they saw only a few straggling whales in February and September. It remains to be seen whether this animal revisits annually the same part of the ocean. So far, it seems probable that he does not; though it does not appear that he remains in any one part all the year round. What then is to regulate his visits from place to place? Probably the abundance of food; therefore this is a subject to which I would invite particular attention. What is the food of the whale? What localities and what temperature of the water are most favorable to its production? How long does it take to mature? Satisfactory replies to these interrogatories would throw much light upon the subject.

"The observations, in addition, required for this work are the latitude and longitude of the ship, the temperature of the air and water, and the set of the current *daily*; the variation of the compass as often as it is *observed*, and the prevailing character of the wind for every eight hours of the twenty-four, stating always the *point* of the compass whence it blows. Besides this, the mention of whales, large quantities of sea-fowl, drift, tide-rips, discolorations of the water, fogs, rain, thunder and lightning, whenever they occur or are seen, with any other remarks that may be deemed of general interest, should be entered in the journal kept for this office. Care must be taken to note in it, also, the kind of whale, whether right or sperm."

Perceiving the importance of the results likely to be obtained, the late Secretary of the Navy authorized these charts to be given to every navigator, who would return to the National Observatory, according to a form, an abstract of his voyages. Several thousand sheets of the chart have already been distributed upon these terms; and there are now engaged, in all parts of the Atlantic Ocean, hundreds of vessels, making and recording observations. Thus it will be seen, that in the course of two or three years the system will probably be nearly perfected, and to this time all intelligent navigators look forward with much interest.

Another result already obtained is, that, by examining the manner in which the charts are cut up by the tracks of vessels, Lieut. Maury is enabled to assert confidently, the non-existence of a number of *vigias*, and other dangers of doubtful position, which disfigure our most accurate charts.

OCEANIC CURRENTS.

WHILE Lieut. Maury is developing in this country a series of charts, showing the actual winds and currents of the ocean, a French *savan*, using like him, the results discovered by others, is endeavouring to assign a cause for these currents. M. Babinet has communicated to the French Academy an hypothesis with reference to the universal law of currents, which he supposes to hold good in the main, though it will be found to be often modified by a great many accidental circumstances.

M. Babinet is not a seaman, but having carefully studied Duperry's "Chart of Oceanic Currents," and observed many other phenomena of physical geography, he has built on them the following hypothesis:—The equatorial zone of the ocean is naturally much broader than the others, therefore it expands and overflows itself to both poles, while the water at the poles flows to the equator to restore the equilibrium; but owing to the revolution of the earth on her axis, the velocity of the water strata, under the equator, is much greater than that of those north and south of it, while the latter have a lesser path to describe. It results from this, that the waters which flow from the equator have an inclination to advance before the motion of the earth, whilst those which come from the poles have a tendency to remain behind the motion. If we cast a glance over the formation of the several continents, the ocean will be found divided into a certain number of basins, in which the force of this law still endures; each basin has an eastern and western shore, and is inclosed on the other side, by the equator and a boundary which may reach to the pole. If the water which comes from the pole to this point attains to the equatorial boundary, then it is behind the motion of the earth, which goes from east to west; the counterpart is found on the boundary opposite the pole, and to complete the course, the water which flows from the pole runs along the western boundary, and that which returns to the equator runs along the eastern boundary. Let us cast a glance on the map of the earth,

and it will be seen that the great ocean is divided into five principal basins. The Atlantic contains two, separated from one another by the equator; the Pacific contains two also separated from one another by the equator; the other is formed by the Indian Ocean, lying between India and Australia. Two circumpolar currents may also be perceived, one of which goes round the north pole, and the other round the south pole from east to west. The theory speaks of certain tracts of water in the middle of each of the basins, where the fluid remains motionless, and where no current exists, shown in the chart by the absence of the arrows marking the direction of currents. Similar but much simpler operations are going on in the atmosphere, producing trade-winds and their counter currents, the cause of which has long been known, and M. Babinet has been led through them to the present solution of the oceanic current phenomena. This double circulation of air and water possesses great influence in the mitigation of the climate, and the consequences would be inconceivable, if, as in the Ptolemaic system, the earth were to stand still, and the sun to revolve round her, for the revolution of the earth on her own axis, and round the sun, is one of the most important elements in the terrestrial system.

THE WATER-THERMOMETER.

Lieut. Maury states that he has been very much assisted in developing his theory of winds and currents by means of the thermometer used by some vessels for determining the temperature of the water. It was by means of these observations on the temperature of the water that he was enabled to prove that off the shores of South America, between the parallels of 35° and 40° S., there is a region of the ocean in which the temperature is as high as that of our own Gulf Stream, while in the middle of the ocean and between the same parallels the temperature of the water is not so great by 22°. Now this very region is noted for its gales, being the most stormy that the as yet incomplete charts of the South Atlantic indicate. Lieut. Maury says, however, that very few navigators make use of the water-thermometer, so that he has experienced some inconvenience in his undertaking. He is the more surprised at this, from the fact that New York owes much of her commercial importance to a discovery that was made by this thermometer. At the time when Dr. Franklin discovered the Gulf Stream, Charleston had more foreign trade than New York and all the New England States together. Charleston was then the half-way house between New and Old England. When a vessel in attempting to enter the Delaware or Sandy Hook met a northwest gale or snow-storm, as at certain seasons she is apt to do, instead of running off for a few hours into the Gulf Stream to thaw and get warm, as she now does, she used to put off for Charleston or the West Indies, and there remained till the return of spring before making another attempt. A beautiful instance this of the importance and bearings of a single fact, elicited by science from the works of nature.

THE BUOYANCY OF THE WATER OF THE DEAD SEA.

"About sunset, we tried whether a horse and a donkey could swim in the sea without turning over. The result was, that although the animals turned a little on one side, they did not lose their balance. A muscular man floated nearly breast-high without the least exertion. A horse taken into the bay could with difficulty keep himself upright. Two fresh hen's eggs floated up one third of their length; they would have sunk in the water of the Mediterranean or the Atlantic. The water of the sea was very buoyant: with great difficulty I kept my feet down; and when I laid upon my back, and, drawing up my knees, placed my hands upon them, I rolled immediately over."

"Tried the relative density of the water of this sea and of the Atlantic,—the latter from 25° north latitude, and 52° west longitude; distilled water being as 1. The water of the Atlantic was 1.02, and of this sea 1.13. The last dissolved one eleventh, the water of the Atlantic one sixth, and the distilled water five seventeenths of its weight of salt. The salt used was a little damp. On leaving the Jordan we carefully noted the draught of the boats. With the same loads, they drew one inch less water when afloat on this sea than in the river. Since our return, some of the water of the Dead Sea has been subjected to a powerful microscope, and no animalculæ or vestige of animal matter could be detected."—*Lieut. Lynch's Expedition to the Dead Sea and the Jordan.*

TO SEPARATE POTATOES OF DIFFERENT QUALITIES.

We learn from the *London Patent Journal* that Mr. James Anderson, of Glasgow, has secured a patent for a plan for the seemingly insignificant purpose of separating potatoes of different qualities, but the method adopted merits attention. According to experiment "it was found that a potatoe containing 20 per cent. of solid nutriment was about the specific gravity of 1.080, that is, taking distilled water at 52° as unity, while the same root with 30 per cent. of nutriment is of a specific gravity of 1.120. Taking this rule, which the patentee found to be invariably correct, he is enabled to divide the vegetables into two or more distinct classes. For this purpose he places them in a vessel containing water brought to a density suited to the quality of the article, which is easily effected by adding salt or clay to the water, and then those which are of less specific gravity will float, while the heavier ones will sink. These two qualities may be again immersed in liquids of different specific gravity, and so again subdivided.

CHEMICAL SCIENCE.

RECENT CHEMICAL DISCOVERIES.

M. Pasteur, of Paris, has availed himself of the beautiful discovery of M. Biot, of the influence of chemical composition in altering the rotation of polarized light, to show that the tartrates and paratartrates differ from each other only in the form of their crystals.

M. Ossian Henry has communicated to the Paris Academy of Sciences a memoir upon the existence of two new bodies belonging to the *amide* series, one a limpid yellowish oil, lighter than water, and disengaging a strong and penetrating odor, which he considers a *bisulphuret of amidogen*,—the other a delicate yellow oil, which, when burnt, gives out an alliaceous smell, combined with a citron-like odor, which he regards as a *sulphocyanuret of amidogen.*

In the Brussels Academy, M. Louyet has given the results of some experiments on the passage of hydrogen gas through solid bodies, by which he shows that this subtile gas passes with facility through paper, and even through leaves of gold and silver. By directing a stream of the gas on one side of the leaf, it may be lighted on the other. As proving the extreme tenuity of the gas and the porosity of the metals, this is important.

Anhydrous nitric acid, which has not hitherto been procured by chemists, has at length been prepared by M. Deville, of Besançon, France, by passing perfectly dry chlorine over equally dry nitrate of silver; no action takes place at ordinary temperatures, but the nitrate must be heated at first to 203° Fahr., and then lowered to 140° or 150°; the decomposition then proceeds quite regularly. At first hyponitrous acid is formed, but on lowering the temperature the new substance is deposited in crystals, in the cooled part of the apparatus; although a cold of 6° was employed to condense the vapors, the crystals were found to form when ice alone was used. The vapor of the anhydrous nitric acid penetrates caoutchouc tubes with such ease, that it is necessary that all parts of the apparatus through which it passes should be solidly joined. The anhydrous nitric acid forms large, brilliant, colorless crystals in six-sided prisms of the trimetric system.

The melting point is 85°, the boiling point 113°. With water much heat is evolved, and solution takes place without the escape of gas; the solution forms nitrates. Decomposition takes place so near the boiling point of the crystals, that the density of the vapor cannot well be determined. On attempting to recrystallize the substance in a sealed tube, in which it had been suffered to liquefy, a violent explosion took place.

LIQUID PROTOXIDE OF NITROGEN.

M. DUMAS has recently communicated to the Paris Academy of Sciences an account of the method used by him in effecting the liquefaction of large quantities of protoxide of nitrogen. He used a force-pump constructed for the purpose, securely bound with a belt of iron. He so arranged it that, the reservoir being surrounded by ice, the body of the pump was cooled by a circulation of water around it, and even the stem of the piston was always moistened by cold water. He then compressed into the reservoir in the course of two hours 200 litres* of gas, of which 20 suffice to produce a pressure of 30 atmospheres, about which liquefaction commences. The remainder of the gas furnishes a liquid. Once compressed, the liquid gas may be preserved in the reservoirs for a day or two, but if the stop-cock is opened the gas escapes, and a portion freezes at first, but soon flows in a liquid state; the solid portion resembles a mass of snow. It melts upon the hand, and rapidly evaporates, leaving a severe burn. The liquid portion, which is far the most abundant, if received in a glass keeps for half an hour, even in the open air.

The protoxide of nitrogen is liquid, colorless, very mobile, and perfectly transparent. Metal dropped into it produces a hissing noise like that of red-hot iron plunged in water. Quicksilver causes the same noise, freezes, and affords a hard brittle mass resembling silver in color. Potassium floats upon the liquid and experiences no change, and the same is the case with charcoal, sulphur, phosphorus, and iodine. Ignited charcoal floats and burns with brilliancy. Sulphuric acid and concentrated nitric acid freeze. Water is converted to ice with a slight explosion.—*Silliman's Journal, July.*

AN ANCIENT ART REDISCOVERED.

AT a late meeting of the Asiatic Society of London, a human hand and a piece of beef preserved by means of a preparation of vegetable tar, found on the borders of the Red Sea in the vicinity of Mocha, were presented; a specimen of the tar accompanied them. Col. Hold, who presented the specimens, observes,—"During my residence on the Red Sea, a conversation with some Bedouin Arabs, in the vicinity of Mocha, led me to suspect that the principal ingredient used by the ancient Egyptians in the formation of mummies was nothing more than the vegetable tar of those countries, which is called by the Arabs Katren. My first trials to prove the truth of this conjecture

* Litre equals 0.220097 parts of British imperial gallon.

were on fowls and legs of mutton, and, though made in July, when the thermometer ranged at 94° in the shade, they succeeded so much to my satisfaction, that I forwarded some to England, and have now the pleasure to send to the Society a human hand prepared in a similar way four years since. The best informed among the Arabs think that large quantities of camphor, myrrh, aloes, and frankincense were used in the preparation of the mummies. These specimens will, however, prove that such additions were by no means necessary, as the tar applied alone penetrates and discolors the bone. This tar is obtained from the branches of a small tree or shrub, exposed to a considerable degree of heat, and it is found in most parts of Syria and Arabia Felix."

NEW METHOD OF PREPARING SULPHURIC ACID.

It has been generally supposed that the elements of sulphuric acid will not combine in a direct manner, and that the presence of water is necessary to insure its formation. Prof. Davy has lately shown that this is an error; and by the following experiment, made before the Royal Dublin Society, he demonstrated the practicability of forming sulphuric acid directly from its elements. Having placed in a dry Florence flask some sulphur, he vaporized it by the application of heat, and then ignited the vapor by means of a red-hot iron rod. The combustion extends throughout the vessel; at the instant of its taking place, both sulphuric acid and sulphurous acid are formed, the former descending in condensed drops, and the latter escaping from the flask. Prof. Davy hopes to render his process available in the manufacture of oil of vitriol.

CHLOROFORM.

Two French chemists have made a minute examination of chloroform and have communicated the results obtained to the *Journal de Pharmacie et de Chimie*, and it is from this that we derive the following statements. In commerce two liquids are known under the name of chloroform, which are of different origin, but are considered identical, and are often substituted for each other. There are, however, considerable differences in their properties; one, which may be called the normal chloroform, being derived from the reaction of hypochlorite of lime upon alcohol, while the other comes from the action of the same substance upon pyroxylic spirit, and differs very much from the first. That derived from pyroxylic spirit, which the authors conditionally call methylic chloroform, although it has the same appearance as the other, has a very different odor, being not sweet and agreeable, but nauseous, and having a burnt or empyreumatic smell. Its density is also less than that of the normal chloroform, and its boiling-point not so high, and its inhalation is far from pleasant, often causing general uneasiness, followed by heaviness of the head, continued nausea, and sometimes vomiting. On examination it was found that the two chloroforms are in reality identical, but that there is in the methylic variety a considerable quantity of foreign matter of an oily consistency, which is composed of several substances, and which it is

impossible at present wholly to expel. This oil is extremely hurtful to the animal economy, so that the normal chloroform is the only one proper for inhalation, and even this should be carefully rectified by distillation, as it often contains foreign substances, which produce the same effects as the methylic chloroform.

COMPARATIVE EFFECTS OF ANÆSTHETIC AGENTS.

DR. C. T. JACKSON, at the meeting of the Boston Natural History Society, April 4th, laid before the Society the results of his observation on the comparative effects of the inhalation of nitrous oxide, the vapor of chloroform, and sulphuric ether. Nitrous oxide, he said, administered in large doses, produces great excitement, which increases with the quantity inhaled. The vapor of chloroform, on the other hand, when inhaled rapidly, causes an immediate and entire prostration. The same is true, in a less degree, of sulphuric ether. They do not produce the intoxication which is caused by nitrous oxide, and this agent also, when administered slowly, fails to produce the usual effects. The vapor of chloroform, slowly inhaled, has an injurious influence, disorganizing the blood, and stopping the circulation in the capillaries. When suddenly introduced it retards, but does not stop, the circulation. Patients to whom it is slowly administered recover slowly, and it is important in all cases that enough air should be admitted with it. Persons inhaling nitrous oxide retain the sensibility to touch, and respiratory action is quickened, increases, and becomes deeper as the inhalation is prolonged. During the inhalation of chloroform and ether, on the contrary, the respiratory action diminishes. Under the influence of exhilarating-gas the system is made very irritable. Dr. Jackson thought that the few cases of excitement after the inhalation of ether might be attributed to the previous state of mind of the patient, or to alcohol combined with it. Conclusions drawn from experiments upon animals with these agents, should be received with great caution, for their action on animals differs according as these have or have not a cutaneous perspiration. It kills those of the latter class. Dr. Jackson recommended a mixture of chloroform with alcohol, in the proportion of an eighth or a quarter of an ounce of the former to four ounces of the latter.

Dr. Warren remarked, that from his own experience he preferred ether to chloroform, as being much safer, and in his own practice used chloric ether in preference to either of the other anæsthetic agents.

USE OF ANÆSTHETIC AGENTS DURING SURGICAL OPERATIONS.

STANISLAS JULIEN has found, in examining the Chinese books in the National Library at Paris, the proof that the Chinese have been long acquainted with the use of anæsthetic agents during surgical operations. The extract which he gives is from a book published about the commencement of the sixteenth century, in fifty volumes quarto,

and entitled, "*Kou-kin-i-tong*,"—*General Account of Ancient and Modern Medicine*,—and refers to the practice of a celebrated physician, Ho-a-tho, who flourished between the years 220 and 230 of our era. It states, that, when about to perform certain painful operations, "he gave the patient a preparation of hemp," (Hachich), and that at the end of a few moments "he became as insensible as if he had been drunk or deprived of life." After a certain number of days the patient was cured, without having experienced the slightest pain during the operation. In a subsequent notice he also shows that the same physicians use the hydropathic system as a cure for certain diseases; among others, chronic rheumatism.—*Comptes Rendus, Jan.* 29.

NAPHTHA VS. CHLOROFORM.

Professor Simpson has been testing the properties of naphtha, which seems to be as good as ether for inducing temporary insensibility. Professor S. administered the naphtha to two patients, a man and a boy, on whom Mr. Milter performed the painful operation of extracting portions of necrosed bones from the tibia, by perforating the newly-formed shell with the trephine, and removing the sequestra with the forceps. The sleep induced was deep and tranquil, and the breathing was less stertorous than when chloroform is employed; but it was remarked, that the effect of the naphtha upon the heart's action was much greater, the pulse becoming extremely rapid and fluttering, thus rendering it less safe as an anæsthetic agent than chloroform.

INHALATION OF HYDROGEN GAS.

M. Van Alsten, of Rotterdam, has recently fallen a victim to his devotion to science. He was the author of a work on chemistry, and was desirous before finishing it of testing to what degree a man might without danger inhale hydrogen gas. He tried the experiment on his own person, and, in spite of all the exertions of his physicians, he died in a few hours.—*Athenæum, June.*

NEW METHOD FOR THE EXTRACTION OF SUGAR FROM SUGAR-CANE AND BEETS.

The most extraordinary and valuable discovery which has been made during the year 1849 is undoubtedly that of M. Melsens, Professor of the State Veterinary and Agricultural College of Belgium, relative to the extraction and clarification of cane or beet sugar. The success which has attended this gentleman's experiments has caused the greatest sensation among the manufacturers and statesmen of France and Belgium. This could not be otherwise in countries where so large a capital is invested in the growth of beets, and the manufacture of sugar from them, in the refining of exotic sugar, and the important collateral interests to which they have given rise. A committee of the most distinguished scientific men of France and

Belgium were appointed by the two governments, and in their presence experiments were made which tested the efficacy and value of the new method. The process for some time was kept secret, but M. Melsens having obtained a patent from the French and Belgian governments, a memoir has been published revealing the essential facts of the discovery and its method of application. The importance of this discovery and its bearing upon the interests of this country, induced Hon. S. G. Clemsen, *Chargé d'Affaires* of the United States at Belgium, to transmit to the Secretary of State a full translation of the memoir.

The following condensed and popular account of the discovery, with remarks on the same, we copy from the *New York Journal of Commerce.*

"In the phenomena of the crystallization of sugar, we encounter a series of anomalies which have baffled the efforts of the greatest chemists, to reduce the incoherent facts to a consistent theory. Berzelius, Dumas, Proust, and other names known in the higher walks of practical science, are associated with investigations into the elementary properties of saccharine juice, and the most effective method of turning those properties to advantage, in the manufacture and extraction of solid sugar. Although the improvements made in this branch of the industrial arts, within the present century, have been numerous and great, they have been very far from approaching the point of excellence attained by other arts, concerned in supplying the luxuries, wants, and necessities of mankind. In fact, it has long been recognized that, among the arts of production, it was in the manufacture of sugar that there remained to be taken one of those strides, which immortalize a name, and signalize an epoch. This stride has recently been taken by a young Belgian chemist, of the name of Melsens, professor in the Veterinary and Agricultural School of the State, at Brussels. It is a certainty that Melsens' discovery is destined to exercise an influence upon the production of one of our national staples, which will be attended with a vast accession of national wealth. The principal features of this discovery may be compressed into a small space.

"It is a well-established fact that the sugar-cane, when in a healthy condition, contains no sugar that is not crystallizable. It is also known that the extraction of this solid is easily effected by means of weak alcohol, which first dissolves it, and then leaves it, by evaporation, in the form of pure and colorless crystals. But, together with crystallizable sugar, there also coexist in the cane certain fermentatives capable of determining a transformation of the sugar into other products. The action of these agents is only rendered possible by placing them in contact with the sugar by means of water, after having been previously exposed to the influence of the external air.

"In bitter almonds there also exists a substance which may be crystallized by alcohol without losing its purity. But the effect is entirely different when water is used in the place of alcohol. This substance found in bitter almonds (amygdaline) disappears or undergoes a metamorphosis, and by the change various new substances are

formed entirely different from the original. That water should have this effect, it is necessary that it should come in contact with the air, and that it should encounter and dissolve certain fermenting substances which are found in the tissue of the bitter almonds, with the amygdaline.

"The rapidity with which the cane juice, in warm climates, undergoes alteration, is the great obstacle to the extraction of the pure solid, and the great cause of loss in the process. The chemist, in his laboratory, solves the problem of the extraction of sugar, by the employment of alcohol. This agent, without producing the slightest alteration in the properties of the sugar, separates it from its associated substances, and protects it from every destructive influence. Alcohol, however, will not answer the purposes of practical industry, which require the employment of an agent low in price and of easy application. Such an agent alcohol is not; it is costly and dangerous as a combustible. But is it beyond the resources of chemistry to discover a liquid which, like alcohol, will separate the sugar and prevent the fermentation which, in the manufacturing processes now in use, ensues as a consequence of the contact of the juice with the external air? Such was the question Melsens proposed to himself, and which he has answered triumphantly by the production of the agent.

"It was step by step, by an infinite series of experiments, and by the concentrated direction of a thoughtful and educated intellect, that Melsens succeeded in detecting and bringing to the light of day what had escaped the scrutiny of Dumas and Berzelius. The first small fact upon which he proceeded was, that, in the tissues of the cane, sugar is found dissolved in water, and it will remain there in a state of preservation for a considerable length of time. From this fact, it was legitimate to infer, that if water could be used as a solvent, the conditions accompanying its presence in the tissues being retained, the saccharine substance could be extracted unaltered. The difficulties, therefore, attending the extraction are not connected with the sugar or the water, but with the air, and the fermentatives which its contact develops. This being the case, were it possible to crush the cane *in vacuo* and to express the juice and boil it *in vacuo*, either for the purpose of purifying or evaporating, nothing would remain to be desired. But this is not possible, at least upon a large scale. Melsens was thus urged to the discovery of an agent absorptive of air, hostile to fermentation, innocuous to man, low in price, and easy of production. Such an agent he found to exist in the *bisulphite of lime*.

"Melsens' experiments with this agent were made upon a dozen varieties of juice, including beet-root juice, or pulp, grape juice, and cane juice. The results were uniform; the sugar crystallized without loss, without trouble, and without the production of molasses. The earlier experiments demonstrated that the bisulphite of lime, employed as a body absorptive of oxygen, and as an antiseptic, had no injurious effect upon the sugar, if applied cold, and in such a manner as to mix with the juice at the very moment of the rupture of the cellular tissues; and further, that in its presence the action of heat

The quantity of water in wheat and flour is greater in cold countries than in warm ones, as there is not so much heat in the former to dry it out in ripening. In Alsace there is ordinarily from 16 to 20 per cent. of water; in England, from 14 to 17 per cent.; in the United States, from 12 to 14 per cent.; and in Africa and Sicily, from 9 to 11 per cent.

It has been ascertained without doubt, that the real value of wheat and other breadstuffs depends mainly upon the proportion of gluten and albumen which they contain, their starch, glucose, and dextrine, or gum, not being considered nutritious. Wheat exceeds all the other cereals in the quantity of nutritive matter which it contains. Southern wheat generally contains a larger portion of gluten than that from more northern countries.

Another important point connected with wheat and wheat flour is the proportion of water or moisture which they contain. To secure their keeping, the proportion of water must be reduced 8 or 10 per cent. Southern flour usually contains less moisture than the Northern. There is less moisture in Southern wheat than in Northern, consequently the flour from Southern wheat will absorb more water and make more bread than that from Northern. The gain in favor of Alabama flour, as compared with that from Cincinnati, is stated to be 20 per cent. The proportion of water in the wheat and wheat flour of the United States is generally less than in those of England, France, and the North of Europe. These are important facts for dealers and consumers.

The presence of water in wheat and wheat flour causes it to sour and become musty. This might be obviated by paying more attention to drying and ventilation. The total amount of loss for the whole United States, arising from chemical changes in breadstuffs by internal moisture, has been estimated at from \$3,000,000 to \$5,000,000 annually. To remedy this great evil, the grain should be well ripened before harvesting, and well dried before being stored. Kiln-drying is, says *The Plough, Loom, and Anvil*, preferable. The mode of ascertaining the amount of water is as follows. Take, say five ounces, and weigh it carefully; then place it in a dry vessel, which should be heated by boiling water. After six or seven hours, weigh it carefully, and the difference shows the original amount of water.

According to a statement made by a quartermaster in the United States army, one barrel of flour, or 196 pounds, when in dough, contains about 11 gallons, or 90 pounds, of water, 2 gallons of yeast, and 3 pounds of salt, making a mass of 305 pounds, which evaporates, in kneading and baking, about 40 pounds, leaving in bread about 265 pounds; the bread thus exceeding in weight the flour employed by about 33.50 per cent.

Fine flour contains a less proportion of nutritive matter than the whole meal (Graham flour), but such is the controlling influence of custom, that it is perhaps in vain to attempt a change, even though its benefits may be clearly proved by the researches of science, and by an extensive experience.

The constituents of flour, according to chemical investigations, are

water, gluten, starch, glucose, dextrine, &c. Gluten is an adhesive, pasty mass, and consists of several different principles, though what these are has not yet been satisfactorily determined. Professor Beck analyzed specimens from different mills, and gives the result. The amount of gluten varies, in these specimens, from 7.00 to 14.25 in 100 parts. The following analysis of wheat flour, from Port Byron, N. Y., will show the relative proportion of the various principles in flour:—

Water	13.60
Gluten	12.00
Starch	67.60
Glucose, dextrine, &c.	6.80
	100.00

Professor B. analyzed some flour from Kubanka wheat, imported from Odessa, and found it to contain 15.25 per cent. of gluten, which exceeds the amount in any specimen of United States flour.

Professor Beck, in the course of his report, also mentions many other interesting facts, which he has either observed himself, or collected from various sources. To show the advantage of drying the wheat properly, he states that in Poland, where the ventilation and drying are continued for some time, wheat has been preserved sound and good for half a century; its age never does it injury, and such wheat yields handsomer and better flour than that obtained from the grain more recently harvested. In Dantzic the preparation for keeping wheat continues for a year, and even longer, after which it is often kept for seven years in the large granaries of that place, perfectly sound.

One of the best methods of determining the real value of wheat and other flours is to examine the bread made from them. The process of making brings out all their defects, and thus affords a good standard of comparison of the various kinds. But it should be remembered that bread is often adulterated for the very purpose of enabling the manufacturer to use poorer kinds of flour. Thus in Belgium and France blue vitriol is often introduced into the dough, so that not only poorer flour can be employed, but less labor is required, and a larger quantity of water is absorbed. Alum also answers the same purpose. The alkaline carbonates, the carbonate of magnesia, chalk, pipe-clay, and plaster of Paris, have all been used, either to correct the acidity of damaged flour, to preserve the moisture, or to increase the weight and whiteness of the bread. All these substances, except, perhaps, the alkaline carbonates in small quantities, render the bread unwholesome. Potato starch, buckwheat, rice, &c., are often mixed with wheat flour.

Professor Beck recommends Mr. J. R. Stafford's process for drying grain, by which "the grain or flour is brought into contact with a surface of metal heated by steam, and a due degree of ventilation, so important to the completion of the drying, is secured. As the heat is not raised above that of boiling water, there is no danger of injuring the quality, color, or flavor of the substances subjected to its action. The

heat is uniform, and the expense is said to be less than that of the mode of drying heretofore generally adopted. By Mr. Stafford's apparatus, 16 or 17 pounds of water are expelled from each barrel of flour, which reduces the proportion of water to 4 or 5 per cent., an amount too small to be productive of injury. Absolute dryness cannot be easily attained, except by a long exposure of the flour to the heat, and it is not necessary for its preservation, a reduction of the water to a small per-centage answering all purposes." Professor Beck says,—"I cannot, in my opinion, render a more important service to dealers in breadstuffs, than to recommend strongly the employment of this or a similar process of drying."

CARBONATE OF SODA AND BREAD.

In a recent letter, Professor Silliman, Jr., advocates the use of carbonate of soda instead of yeast in making bread. He says,—"I have paid some attention to the method of making bread by carbonate of soda and muriatic acid, and have eaten with pleasure of bread so made. The result of the mixture of these materials in the proper proportions of flour, is to set at liberty such a quantity of carbonic acid gas as is necessary to thoroughly raise the bread on the instant in the process of baking. The salt formed by the union of the alkali with the acid is just sufficient to flavor the bread pleasantly, and no objection can rest against the process when properly conducted. The ordinary mode of kneading dough with yeast is vastly more laborious and difficult in every respect than the quick process. The yeast employed in fermentation is objectionable as being a substance far advanced in decomposition, and not always free from an unpleasant acidity, which it imparts oftentimes to the bread made from it, although in a degree which may not make it unsaleable. The process of fermentation is carried on in the dough at the expense, first, of a certain amount of sugar which is present in all good flour, and when this is all converted into gas, then the starch of the flour is attacked, until the progress of change is arrested by the oven. The loss of weight sustained by the flour in the usual fermentative process is all saved by the quick mode. There is a certain breaking up of the starch globules by the fermentation, and probably also a change in the consistency of the glutinous part of the flour, which makes fermented bread peculiarly tender and friable, which is an advantage that may be fully compensated in the quick bread by longer baking. I am informed that bread made by the quick process requires a much more considerable time in the oven than fermented bread."

STARCH FROM HORSECHESTNUTS.

M. Belloe stated to the Paris Academy of Sciences, at their meeting on Jan. 15th, that he had obtained perfectly white and tasteless starch from the horsechestnut, by simple washing in cold water and decantation. With rough apparatus he obtained from 19 to 21 per cent. of starch from the pulp of the fruit, while a comparative experiment gave him but about 12 per cent. But on January 22d, M.

Flandin called the attention of the Academy to the fact, that the specimens presented by M. Belloe still retained a perceptible bitter taste, and exhibited another specimen obtained by him, by washing with carbonate of soda, which was entirely devoid of taste.—*Journal of Franklin Institute, May.*

METHOD OF DETECTING THE FLOUR OF INDIAN CORN WITH THAT OF WHEAT.

THE sample is sifted, and 2 grams* of the finest flour mixed with 4 grams of nitric acid in a test-tube, and well stirred with a glass rod. After this, add 60 grams of water, and then 2 grams of carbonate of potassa dissolved in 8 grams of water. When no Indian corn is present, as soon as the carbonic acid has escaped only yellowish flakes separate; but when any admixture has been made, some orange-yellow particles subside, which are easily detected. In this way an admixture of from 4 to 5 per cent. of Indian corn with wheaten flour may be detected.—*Jour. de Chim. Méd.*

METHOD OF INCREASING THE CREAM FROM MILK, AND OF PRESERVING MILK.

A NEW method of increasing the quantity of cream produced from milk, and of preserving milk, has been discovered in Belgium. The invention consists, first, in a method of increasing the quantity of cream produced from milk, by the addition of one table-spoonful of the liquid hereafter described to every quart of new milk; the milk is then stirred and left in the pan or vessel; the skimming may take place at the expiration of the usual time, but it is better to wait a little while. By the application of the liquid a much larger quantity of cream is forced to the surface of the milk than can be obtained in the ordinary way. The liquid is prepared by adding to one quart of water one ounce of the carbonate of soda, one teaspoonful of a solution of turmeric or curcuma, and three drops of marigold-water. The soda is first mixed with the water, and then the other ingredients are added. It is the soda and water which form the basis of the discovery, the others being only used to improve the color and quality of the butter, and are not necessary to effect the increase of the cream.

The second part of the discovery consists in the following method of preserving milk. "One table-spoonful of a solution of soda, made by dissolving one ounce of carbonate of soda in a quart of water, is introduced into a quart bottle nearly filled with new milk. The bottle is then corked, the cork being securely fastened, and the bottles are put into a copper or other vessel containing cold water, which is to be gradually brought to the boiling point, after which the bottles must remain in the water till cool, when they may be packed away." If this discovery is really new and efficacious, it is an important one; at any rate it can easily be tested.

In connexion with this subject a German periodical gives the following method of testing milk. "Put into a saucer one tenth of an ounce

* A gram equals nearly 15½ grains Troy.

of pulverized gypsum, and pour over it half an ounce of the milk to be examined. As soon as this mixture becomes warm, the milk is decomposed, when the butter and cheese attach themselves to the gypsum, so that we can let it boil freely without danger of losing any portion of the solid substances. When the contents of the saucer have reached a doughy consistency, which occurs in fifteen minutes, the heat must be diminished. The paste should then be dried, a vapor-bath being the best way, when it is soon changed into a grained powder; having ascertained by weighing, at short intervals, that the water has disappeared, we find the proportion of solid elements in the milk by noting the difference in weight between the saucer now, and when empty. If we desire to find also the quantity of fatty matter which is contained in the solid residuum, we have only to extract the powder in it by means of sulphuric ether, and the loss of weight thus occasioned gives the quantity of fat which is contained in the milk. On an average, pure milk contains from 10 to 12 per cent. of fatty matter, though this is often reduced one half by adulteration."—*Condensed from the Patent-Office Report for* 1848.

IMPROVED METHOD OF PRESERVING MILK.

The following improved method of preserving milk has been discovered and patented by M. F. H. Louis. The milk is to be mixed with well-clarified raw sugar, four ounces to the gallon. It is then to be evaporated with agitation. When nearly solid, it must be pressed into cakes of suitable size. Steam may be used for the evaporation; or, if time is no object, spontaneous evaporation in very shallow pans, with the fluid not more than one tenth of an inch in depth, or a drying chamber may be used, the temperature not to exceed 122° Fahr. The cakes remain sweet and fresh for a long time, and are soluble in warm water. Another process is, to heat the sweetened milk nearly to the boiling point, and before it becomes cold, to curdle it by rennet or a weak acid. The curd is separated from the whey, and by strong pressure, after washing in cold water, it is obtained free from adhering water. The whey is to be evaporated to dryness. The curd, placed over a slow fire, is continually stirred, and the dried whey added very gradually, with a small portion of bicarbonate of soda. After a while, the ingredients melt and unite. A small quantity of finely pulverized gum dragon hastens the solidification. Cream may be preserved by the same methods.—*Chemical Gazette.*

ADULTERATION OF PORT WINE.

The *Westminster Review* for October contains some extracts from a recent pamphlet, entitled "A Word or Two on Port Wine."

The author of the pamphlet in question, Mr. Joseph James Forrester, thus explains his object in its publication:—The qualities of port wine most prized have been different at different periods. Sometimes dryness and astringency, sometimes fruitiness and smoothness,—at one time, great delicacy, and at another, fulness,—have been sought

for. Each of these qualities is consistent with purity; but *naturally*, according to the kind of grape, the soil, height, and aspect of the vineyard where it is grown, will the wine have one or more of these qualities, in a greater or less degree, as the season is good or bad. One would imagine, that, from among these varieties, the most fastidious might select a *pure* wine to suit his palate, and so no doubt he would if he were fairly treated; but unfortunately, for a considerable time past, the practice of the wine-merchants has been to disregard all the circumstances just mentioned, and to try to produce in all seasons, wet or dry, cold or hot, from grapes in every variety of situation, and of all qualities, wines of one and the same kind only, viz., what is called by some, "full, high-colored, and fruity," but by others, more properly, "black, strong, and sweet." The taste which has gradually led to this state of things probably was good, and occasioned by an extraordinarily fine vintage, such as that of 1820, when all the vines were *naturally* unusually full, sweet, and high-flavored. The merchants, finding these wines much sought for, insisted upon having the like at all times; and as such wines could seldom be obtained pure, seasons so fine being extremely rare, recourse was had to adulteration to produce something like it, and the struggle among many of the exporters was to send wine, each fuller, sweeter, and higher-colored than that of his neighbour. In this practice they were encouraged by petty innkeepers, retail dealers, and others, who found it answered their purpose admirably. A portion of such wine mixed with Benecarlo, or other harsh inferior red wine, enabled the whole to be passed off as *port*. In negus, it is plain the use of it would cause a saving of all the ingredients except water; and to palates hardened by the use of strong or coarse liquors, it would probably be more acceptable than wine of the highest flavor. Persons of these kinds, therefore, continued to call for *black*, *strong*, and *sweet*, until, at length, the attempt to imitate a really fine wine has degenerated into such a system, that, of the "port" sent to England, a very large portion hardly deserves to be called wine, at all, and still less port wine.

Mr. Forrester then gives the following description of the process of manufacturing the *black draught* which has for some time past received in England the name of port wine. To produce *black*, *strong*, and *sweet* wine, the following are the expedients resorted to. The grapes, being flung into the open stone vat indiscriminately, on the stalks, sound and unsound, are trodden by men till they are completely mashed, and then left to ferment. When the wine is about half fermented, it is transferred from the vat to tonels, and brandy (several degrees above proof) is thrown in, in the proportion of twelve to twenty-four gallons to the pipe of must, by which the fermentation is greatly checked. About two months afterwards, this mixture is colored thus: a quantity of dried elderberries is put into coarse bags; these are placed in vats, and a part of the wine to be colored being thrown over them, they are trodden by men, till the whole of the coloring matter is expressed, when the husks are thrown away. The dye thus formed is applied according to the fancy of the owner;

from 28 to 56lbs. of the dried elderberry being used to the pipe of wine. Another addition of brandy, of from four to six gallons to the pipe, is now made to the mixture, which is then allowed to rest for about two months.

At the end of this time it is, if sold, transferred to Oporto, where it is racked two or three times, and receives two gallons more of brandy per pipe; and it is then considered fit to be shipped to England, it being about nine months old; and at the time of shipment, one gallon more of brandy is usually added to each pipe. The wine, thus having received at least 26 gallons of brandy per pipe, is considered by the merchant *sufficiently* strong,—an opinion which the writer, at least, is not prepared to dispute.

This is one way. Another way is this. The finer sorts of grapes are selected of several kinds, those which are decayed or unripe being removed. They are then trodden, as in the preceding case, but the fermentation is allowed to proceed three fourths of the full time proper for it. The wine is then transferred to the tonels, where it receives from six to ten gallons of brandy, of the same strength as that before mentioned, per pipe. About two months afterwards it is drawn off into other tonels, and each pipe receives about six additional gallons of brandy, and from six to eighteen gallons of jeropiga. The wine is then sent to Oporto, where the future treatment proceeds as in the first case, except that it receives there, on the whole, five, instead of two, gallons more of brandy. Of the port shipped for the English market as "vintage wine," that is from nine months to two years old, at least two thirds is made in one or other of the ways just mentioned. It may be well here to observe, that the practice of sending these new wines is any thing but advantageous to the consumer. Port wines of this age are too astringent to be offered to him *pure*; but by the use of sweetening and other ingredients, they are rendered softer to the palate, and acquire a false appearance of maturity, and thus the inexperienced are deceived. Of the remaining third of the wine which goes to England, only a very small portion is without a considerable admixture of jeropiga. Some is made from an indiscriminate mixture of grapes, and some from grapes carefully selected and culled; but each kind has the advantage of being fully fermented, and also that of remaining without jeropiga till that fermentation has ceased. This is the best kind of the adulterated wines; but still it has not received less than 25 gallons of strong brandy.

The coloring matter of the grapes, produced by a complete fermentation on the husk, varies in intensity according to the character of the grape, but imparts no smell to the wine. This color varies from a *pale rose* to a *bright purple* (never deeper except where souzao is used), is *perfectly transparent*, and mellows with age; the rose becomes tawny, and the purple ruby,—both of which colors are durable. The deepest of the artificial coloring matters, or dyes, at present used, is elderberry. It is employed indiscriminately with any and every quality of grape, and imparts a disagreeable medicine-like smell wherever it is used. It gives at first a dull, very dark purple hue, like dirty ink, to the wine; and, in course of time, changes to a brick

color, or falls altogether, until the wine assumes its original imperfect tint.

We do not wish to "horrify" any one; but those who take a pint of such port as we have reprobated may be assured that they take nearly as much alcohol as is contained in the same quantity of cherry brandy. Let us examine the matter a little. A pipe of wine contains 21 almudes. We have shown before that the average quantity of brandy in a pipe of the port wine brought to this country is 4 almudes; the pipe, therefore, contains 17 almudes of what is called wine, and 4 almudes of adventitious brandy. We have also seen that 8 pipes of the commonest and weakest wine will yield 1 pipe of brandy; therefore, 17 almudes of fully fermented wine will yield $2\frac{1}{8}$ almudes of brandy. But supposing that, the fermentation of the 17 almudes having been checked, they are equal in strength to the 13 almudes of wine properly so called, then they will yield, if distilled, $1\frac{5}{8}$ almudes of brandy. But this brandy is of the strength of 10 degrees of Tessa, or 26 per cent. above proof, whereas the spirit used in making cherry brandy is about 17 per cent. below proof, or more than 43 per cent. below the strength of the brandy in the pipe; therefore, the $5\frac{5}{8}$ almudes of brandy which the pipe contains of 10 degrees of Tessa, are equal to $7\frac{13}{16}$ almudes of the spirit used in making cherry brandy, consequently the pipe contains more than one third of spirit, 17 per cent. below proof! Any gentleman may ascertain from his housekeeper the proportion of brandy used in making cherry brandy.

A vigorous effort is now, however, making to do away with this wholesale adulteration.

ADULTERATION OF DRUGS.

At a meeting of the New York Academy of Medicine, June, 1849, an elaborate report was presented by Dr. M. J. Bailey, on the practical operation of the law prohibiting the importation of adulterated and spurious drugs, medicines, &c.

The report states, that since the law took effect, July, 1848, over 90,000lbs. of drugs of various kinds have been rejected and condemned in the ports of the United States. Of these, 34,000lbs. were included under the comprehensive title of Peruvian bark, 16,343lbs. rhubarb root, 11,707lbs. jalap root, about 2,000lbs. senna, and about 15,000lbs. of other drugs. The agitation of the bill which preceded the passage of the law had its effect abroad, and the supply of adulterated drugs from foreign markets has greatly decreased. The domestic supply has, on the contrary, increased. Within a recent period, quinine in considerable quantities has been found in the market, adulterated to the extent of some twenty or twenty-five per cent. These frauds were undoubtedly perpetrated by or among our own people. The material used for the adulteration of the quinine was found, on analysis, to be *mannite and sulphate of barytes*, in nearly equal weights. The latter article has long been used for this purpose, but not until lately has *mannite* been detected in the sulphate of quinine. It seems to have been ingeniously substituted for salicine,

and a somewhat similar substance prepared from the poplar bark; which articles have heretofore been extensively used for like purposes. The ingenuity consists in the fact, that it is much more difficult to detect the adulterations when effected by the admixture of *mannite*, than when by the admixture of salicine, &c., while the former can be furnished for less than one fourth of the expense of the latter.

For some years past an extensive chemical establishment has been in operation at Brussels, in Belgium, built up at great expense and care, and expressly designed for the manufacture, on a large scale, of imitations of all the most important foreign chemical preparations used in medicine; while, at the same time, an agent was travelling in this country making sales and soliciting orders in all the principal towns on our seaboard. The articles were prepared and put up with consummate skill and neatness; and the imitation was so perfect that it was impossible for the unsuspecting purchaser to distinguish them from the genuine, notwithstanding that in some instances they did not contain over five per cent. of the substance represented by the label. Since the law went into effect, at the port of New York, not a single package has been presented for entry. Dr. Bailey states, however, that he has been informed that the persons formerly connected with the Brussels firm are now in this country engaged in the same iniquitous business; hence the adulterations spoken of.

VALERIANATE OF MORPHIA.

The following account of the valerianate of morphia, a new medicine, has been communicated to the American Association by Dr. M. Wyman and Prof. Horsford.

"It is well known to the physician that opium, besides procuring sleep, allaying or entirely removing pain, and suspending the mucous secretions, also produces other and undesirable effects, which materially diminish its usefulness. Various attempts have been made to prevent these effects, at first by using different solvents of the drug, and, afterwards, by separating the morphia from the other substances with which it is combined; usually, on account of the greater solubility of these salts, in the form of a sulphate, a muriate, or an acetate. Although the objectionable properties of opium are diminished with most persons when taken in these forms, still there are some who suffer as much from the one as the other. Neither is it known that the acids in the salts just mentioned have any medicinal influence in themselves when so combined, or that they materially change the action of the morphia; although it is so well known that the therapeutic effects of opium are very materially changed by being mixed or combined with other drugs. With the view of obviating these objections, Prof. Horsford, at the suggestion of Dr. Wyman, has prepared a new salt, known as valerianate of morphia. The valerianic acid was made by the oxidation of fusil oil,—one of the incidental products of fermentation in the manufacture of alcohol. This oxidation was effected by means of bichromate of potassa and sulphuric acid. The acid distilled from the solution was converted into valeri-

anate of baryta, and this salt, by double decomposition with sulphate of morphia, was resolved into sulphate of baryta, which fell as an insoluble powder, and valerianate of morphia, which, after filtration and concentration, crystallized in beautiful forms of great transparency.

"The effects of this new medicine are as follows:—In small doses it is found to produce more quiet sleep, and to be equally efficacious in removing pain with its equivalent in crude opium, or the salts of morphia. In a case of violent nervous excitement it acted most favorably, producing quiet and sleep after other preparations had failed. It has been given in a few cases in which, from constitutional peculiarity, a feverish state ensues, with watchfulness and starting instead of sleep, or quiet reverie. In these the sleep was not continuous, but the intervals of wakefulness were shorter, and the general frame of mind more calm. The subsequent effects, headache, nausea, and vomiting, were decidedly less than after an equivalent of the other preparations. In full doses, also, the subsequent effects are less. In dysentery this has been observed in a marked degree. The doses were from one third to half a grain, repeated from eight to ten times in twenty-four hours. The secretions were lessened, the evacuations controlled, and the pain removed, with less headache, nausea, and vomiting. The dose is about one fourth that of crude opium; it is most conveniently given in the form of a pill."

The valerianate of morphia has now come into general use, both in this country and in Europe. In England its discovery has been claimed as having originated there.

ON BENZOLE AND ITS USES.

THIS body, which may be procured to any extent by the distillation of coal-tar, or light naphtha, promises to be of so great utility in the arts as to encourage a belief that it will soon form a special object of manufacture and commerce. It is a limpid, colorless liquid, of an agreeable ethereal odor. It dissolves many substances with extreme readiness and in large quantities, such as the various resins, mastic, camphor, wax, putty, and essential oils, caoutchouc, and gutta-percha. Its volatility gives to its solution of either of the two latter substances the useful property of drying rapidly and perfectly; so that, when spread upon glass or any polished surface, a film of the gum is deposited, which may be readily peeled off in the form of a tough membrane of any required degree of tenuity, and possessing all the properties of the original material. The same solutions, varnished on the skin, form admirable artificial cuticles, which have been found useful in cures of wounds and burns, and might probably be very beneficial in some skin diseases. It dissolves gamboge in small quantity, and shell-lac even more sparingly; but it will mix in equal bulks with a saturated solution of lac in wood spirit or alcohol. This property may be valuable to varnish-makers. Copal and anime yield but slightly to the solvent power of this fluid; but its vapor in the act of condensation rapidly dissolves these resins; so that, if frag-

ments of them be suspended in the head of a vessel in which the hydrocarbon is boiling, the vapor, as it condenses on their surfaces, softens and dissolves them, and trickles back into the vessel below, in which a colorless varnish will result, more or less concentrated according to the duration of the process. Benzole dissolves quinine, depositing it on evaporation in a crystalline form; the condensing vapor dissolves the alkaloid, especially if not recently precipitated, more readily than the boiling liquid. It dissolves iodine, phosphorus, and sulphur; and, when boiling, takes up the latter in large quantity, of which, however, the greater part crystallizes out as the fluid cools. It has been found extremely useful in the laboratory as a solvent in researches in organic chemistry, where the high price and almost too great volatility of either render a substitute for that agent a great desideratum. The facility with which the vapor of benzole is taken up and retained by the air at its ordinary temperatures, has been taken advantage of in an apparatus for illumination, with great success; in this a stream of it is made to pass through a reservoir of the volatile hydrocarbon, and afterwards conducted to burners, at which, being ignited like coal-gas, it yields a light of extreme brilliancy and whiteness. The property possessed by alcohol, of burning with an almost lightless flame, so opposite to that of the highly carbonized benzole, renders it easy, by properly adjusting a mixture of the volatile oil with the spirit, to obtain a fluid which shall be readily vaporized and shall yield a flame of any required degree of whiteness. Thus, a mixture of one part by measure of benzole, and two parts of spirit of specific gravity about 0.840, forms an excellent fuel for a portable gas-lamp, which supplies itself with vapor by the heat which it generates in combustion. Any excess of spirit diminishes the luminosity of the flame, while too much of the benzole causes a tendency to smoke.—*Chemical Gazette.*

NEW MODE OF ILLUMINATION.

At the meeting of the Institution of Civil Engineers in London, on April 17, Mr. C. B. Mansfield read a paper "On an Application of certain Liquid Hydro-carbons to Artificial Illumination." The system proposed consists in conducting a stream of almost any gas, or even of atmospheric air, through a reservoir charged with benzole or some other equally volatile hydro-carbon; the gas or air being then conducted like common gas to the burners. It was stated that this system is applicable on any scale, from the dimensions of town gas-works to the compass of a table-lamp. In an apparatus exhibited, a small gas-holder, filled by a pair of bellows, supplied common air through pipes. The gases formed by passing steam over red-hot coke would answer well for this purpose, and it would depend on local circumstances whether this mode of generating the current would be preferable to the expenditure of the mechanical force necessary for driving atmospheric air through the pipes. By decomposing water with the voltaic battery, naphthalizing the hydrogen with benzole, and burning it with the aid

of the equivalently freed oxygen, a simple light of intense power may be obtained. This system was shown to be a great simplification of the ordinary system of gas-lighting, as no retorts, metres, &c., are required, and the products of combustion are as pure as those from the finest wax. It is expected that the elegance of the material and the simplicity of the apparatus will cause its introduction into buildings and rooms where coal-gas is not now considered admissible. Though this liquid does not require to be heated above the average temperature of the air, yet it is liable to be cooled by its own evaporation, so as to require an artificial supply of warmth, which is obtained by causing a small jet of flame of the gas itself to play upon the reservoir, and by a simple contrivance the temperature is made self-regulating, so that it never rises above nor falls below a proper degree. If atmospheric air is used as the vehicle for the vapor, the jet-holes in the burner must be slightly larger than those for coal-gas. Some burners were exhibited, contrived for the purpose of accurately adjusting the size of the orifice to the quantity of gas escaping; by moving a part of the burner, they were made to give any required quality of flame from lightless blue to smoky, the medium point furnishing the greatest brilliancy. A gallon of benzole of the requisite purity will cost about 56 cents, and to this must be added the expense of the air-current and the interest on the original outlay, which at the most would raise the cost to about 90 cents for the consumption of a gallon of benzole. One ounce of the liquid will give a light equal to four wax candles for an hour; or one gallon for about 120 hours. It is inferred that a gallon of this material is equivalent to about 1,000 cubic feet of coal-gas. A gallon of benzole weighs but 7lbs., while the coal necessary to produce the same amount of coal-gas weighs 200 lbs. at least, giving an advantage of 28 to 1 over coal, where the mines are at any considerable distance.

EXPERIMENTS ON BURNING FLUIDS.

The results of some important investigations with reference to burning fluids have been communicated by Prof. Horsford to the American Academy. "It has been maintained by many that several of the various preparations under the general denomination of *burning fluids* are, in certain conditions, explosive. It has been asserted by venders, on the other hand, that they are not explosive. Wherein the misapprehension lies, how the numerous accidents that have occurred in the use of burning fluid are to be explained, and by what precautions the repetition of these accidents may be prevented, have been subjects of experimental inquiry. The burning fluids as a class are rectified spirits of turpentine, or turpentine with an admixture of a small percentage of highly rectified spirits of wine, or of some other inflammable body readily soluble in turpentine or alcohol. Turpentine, alcohol, and ether, when fired in an open vessel, burn at the surface so long as a supply of oxygen is kept up. The accidents with burning fluids have ordinarily occurred during the filling of lamps from the cans, and always in the presence of flame, from a burning lamp

or other source. In these facts lies the explanation of the phenomena that have been observed.

"The general principle, that a mixture of a highly combustible gas with oxygen or atmospheric air is explosive, suggested the idea, that, in the chamber above the burning-fluid in the flask from which the lamps are filled, there might be an admixture of the vapor of the burning-fluid in such proportion with atmospheric air as to make it susceptible of explosion. To test the value of this suggestion, experiments were made with alcohol by directing a current of air into the upper part of a loosely stoppered laboratory glass spirit-lamp, while burning, causing thereby a mixture of alcohol-vapor and air to rush past the flame. After a moment or two the jet took fire, and was instantaneously followed by explosion. The result was invariable. After permitting a drop of alcohol in a large glass flask with a small neck to evaporate for a moment, and applying flame to the mouth, explosion resulted generally, but not invariably. Ether similarly treated yielded less uniform results, because probably of the greater difficulty in obtaining the proper mixture of the vapor of ether and air. A variety of burning-fluid in extensive use, said by the venders *not to explode*, was subjected to similar experiments, with still less frequent affirmative results. They were, however, sufficient to show that explosions with them are possible. Similar experiments have been made with another variety of burning-fluid by Dr. M. Wyman, with like results. It is, then, conceivable, that, when the proper relative amounts of burning-fluid vapor and atmospheric air are mixed together, as they may be in the upper part of a partially filled can or receiver, and a flame is brought sufficiently near, explosion must result. If the quantity of mixed gases be large, the explosion may cause the destruction of the containing vessel, or, if that remain entire, it may drive out a portion of the fluid, which, taking fire, may cause more or less injury. The course of safety has been pointed out by the dealers in these articles for illumination. It is to fill the lamps (the tops of which are without special air-holes and which screw on) in the *absence of flame*, by daylight, for example, in which case no explosion can occur.

"Similar accidents to the above have taken place in the use of the so-called air-tight stoves for burning wood. After the wood has been fired, and the supply of air for some time shut off, on reopening the draft, and sometimes even without, occasionally explosions of great violence have occurred, attended with the blowing off of the door, and, in some instances, producing still greater injuries to the stove. The probable explanation is this. After firing the wood and shutting off the draft, destructive distillation commences and inflammable gases issue from the wood, which, mingling with air derived from the pipe or remaining still unconsumed, furnish an explosive mixture, which the first jet of flame, or perhaps the incandescent coal, causes to explode. As these accidents are not of frequent occurrence, it may be found that the probability of producing inflammable gases in the required quantity is less with some varieties of wood than with others."

NEW MATERIAL FOR THE PRODUCTION OF GAS.

A VERY interesting experiment has recently been tried in Paris before several distinguished members of the Academy of Sciences. The fact to be demonstrated was, that, by the decomposition of grape-skins and the lees of wine in a close vessel, a carburetted hydrogen gas would be disengaged, of such a superior quality as to lead to the supposition that it could be used in the place of the gas ordinarily obtained from coal and resin. A pound of dried grape-skins, placed in a white-hot retort, furnished, in less than seven minutes, three hundred and fifty quarts of excellent carburetted hydrogen gas. The gas burns with a brilliant white flame, is without odor, and emits little smoke in comparison with that produced from pit-coal and resin. An experiment with the dried dregs of wine was equally satisfactory.

ISOLATION OF ETHYLE.

WE learn that Mr. Frankland, who has for some time been pursuing his chemical studies in the laboratory of Prof. Bunsen, of Marburg, has discovered ethyle, the base of ether. The isolation of this interesting base will doubtless tend to the elucidation of many involved questions connected with the phenomena of etherification; and it must consequently prove of great interest to all chemists.—*London Athenæum, June.*

The radicals methyl and amyl, have been isolated by the same chemist since the date of the above.—*Editors.*

CARBONIC ACID AS A MEANS OF EXTINGUISHING FIRES IN COAL-MINES.

WE extract from an English paper some interesting facts with reference to the extinction of fires in coal-mines by means of carbonic acid. The authority for the statements is the proprietor of the Astley collieries, where the experiment was tried with complete success.

When a fire is discovered in a mine, it is usual to close all the openings, so as to prevent any access to the atmosphere, and if this does not extinguish the flames, water is then introduced into the mine. It is found impossible to seal up all the openings so closely as to extinguish the fire, as is shown in the case of Lord Bradford's collieries, at Bolton, and those of the Earl of Ellesmere, at Worsley, which have been on fire for the last two years. The fire at the Astley collieries broke out with great violence, and the proprietor being unwilling to lose so much time and to flood his mines wrote to Mr. Gurney, the author of a plan for ventilating mines by means of high-pressure steam, inquiring if he could suggest any plan for the speedy extinguishment of the flames. Mr. Gurney proceeded at once to Astley, and after some investigation suggested that the mine should be filled with carbonic acid, azote, or some other extinguishing and incombustible gas, but it was objected that the expense necessary to procure enough of the gas to fill a mine containing three miles of passages would be immense. Mr. Gurney, however, obtained permission to

build a small brick furnace, four feet square, at a safe distance from the down-cast shaft. The ash-pit was made entirely tight, except that it had an iron cylinder thirteen inches in diameter connected with it, which terminated at an elbow under water in a tank partly filled. With the upper part of this tank above the surface of the water another pipe was connected and carried into the shaft leading down into the mine. A powerful steam jet was made to work between the furnace and the tank, which drew the air down through the fire and forced it through the water, while a second jet was placed in the cylinder at the top of the down-cast shaft, and made to draw the choke-damp from the tank and force it into the pit. It should be mentioned, that this choke-damp was the product of the combustion of coal assisted by a little charcoal and lime, through which the air was passed by the contrivance described, and thus was deprived of its oxygen, and the azote set free. At the up-cast shaft or outlet upwards, corresponding to the down-cast shaft already mentioned, a third jet was placed in a cylinder and made to exhaust from the shaft beneath, so as to assist the other or compressing jets and draw the choke-damp through the galleries between them. All having been arranged, the apparatus was put in operation, and in order to test the choke-damp and see if it was perfectly formed, burning tow moistened with turpentine was placed in it, and was found to be immediately extinguished. This experiment, therefore, was so far perfectly satisfactory. The jets were kept in action, and at the expiration of two hours fire-damp disappeared from the shafts, and at the up-cast shaft a slight cloudy appearance was observed in the air which escaped, and this had the sulphureous smell of choke. This indicated that the choke-damp had passed entirely through the mine, but in order to prove it satisfactorily the draughts were shut off for a short time, and, a safety-lamp being placed in the up-cast cylinder, it was immediately extinguished, proving the presence of the choke-damp in considerable quantities. During the two hours, six thousand cubic feet of the damp had been forced into the mine every minute. After being allowed to remain closed for some hours longer, the connection with the furnace was broken, and fresh air was driven through the same jets, which forced out all the choke-damp in about two hours. The mine was then regarded as perfectly safe, and several men descended the down-cast shaft three hundred and ninety feet, to the tunnel leading to the working, and all was found clear. The exhausting jet having been kept up all night, the next day some of the men passed through the workings and found all safe. The fire was entirely extinguished, and the action of the single jet was found to produce a more powerful current than could be done in any other way. The experiment was therefore perfectly satisfactory, but the steam-jet is still kept in operation to ventilate the mine, which it does so effectually, that there is no need of safety-lamps, and the men are working by naked candles. It will be seen that by this means a great saving of time is effected in the extinguishment of those fires to which all collieries are so liable, as, instead of the months or years required for sealing up, flooding, and pumping out again, only two days are necessary to extinguish the most violent fire, and this, too, at a very trifling expense.

A modification of this plan is proposed for extinguishing fires in ships. It is proposed to fill with chalk or broken marble several flat vessels, which are to be distributed in the lowest part of the ship, and near them are to be placed vessels containing muriatic acid, which are connected with other vessels of carbonate of lime by valved pipes. These valves must be furnished with strong wires leading to the deck. As soon as the fire shows itself, all ports and means of communication with the open air must be stopped. The valves may then be opened by means of the wires, and the acid will flow upon the carbonate of lime, producing large quantities of carbonic acid. This gas, being heavier than common air, will displace it, and the whole ship will be filled with it, so that all combustion will be at once extinguished.

VOLATILIZATION OF CARBON.

By the *Comptes Rendus* we learn that M. Despretz has commenced a series of experiments on the fusion and volatilization of various refractory substances. As one of his first results, he announces the fusion and volatilization of carbon. He used a battery of 496 elements in four parallel series. Carbon from sugar in an "œuf electrique" was subjected to its action; a high degree of incandescence was produced, and the globe was covered with a black powder, dry and crystalline. After many precautions to test the reality of the result, and various changes in the mode of experiment, Despretz satisfied himself that the effect was owing to a volatilization of the carbon. In one case, when the carbon reached a white heat, some white traces were deposited on the sides of the vase; then suddenly it was reduced to a state of vapor, with nearly the appearance which iodine presents when a fragment is cast on a heated body. The glass was lustrous with the crystalline sublimate. This result failed with less than 496 elements. Experiment has further shown that carbon is best fused into globules in nitrogen under a pressure above the ordinary atmospheric pressure. Glass vessels break so easily that metallic must be used.

The authority from which we copy the above, *Silliman's Journal*, states that the fusion and volatilization of carbon was long since announced (as early as 1822) by Prof. Silliman, while the condensation of carbon upon the inner surface of a globe has been a frequent class experiment with Prof. S., and has been customarily mentioned in his lectures as a case of vaporization. The battery used consists of 900 pairs, being one of the largest ever constructed; but Prof. Silliman, Jr., has shown that the same result may be obtained by a Bunsen's battery of 60 pairs. Prof. Silliman has also melted various other refractory substances, which had never before been fused, and in due time we shall probably learn that Despretz has succeeded in doing the same. This is not the first time that Prof. Silliman has far preceded the chemists of the Old World.—*Editors.*

EXPLANATION OF THE TRICKS OF FIRE-JUGGLERS.

M. P. H. Boutigny states in the *Comptes Rendus*, that, his attention having been turned to the "spheroidal state of bodies," he sus-

pected that this would account for many of the wonderful feats described, such as walking barefooted across liquid metal, plunging the hand into molten lead, &c. His object, then, was to find out some one who had seen or performed these or similar feats, and after some trouble he finally learned from M. Michel, who lives in a district of France where there are many forges, that he had not only seen a workman pass his fingers through an incandescent jet of fluid metal, but had himself performed the experiment.

Encouraged by this announcement, he proceeded to make some experiments himself. He says,—"I divided or cut with my hand a jet of melted metal of five centimetres, which escaped by the tap. I immediately plunged the other hand into a pot filled with incandescent metal, which was truly fearful to look at. I involuntarily shuddered, but both hands came out of the ordeal victorious." After some further unimportant remarks, he observes,—"I shall of course be asked what are the precautions necessary to prevent the disorganizing action of the incandescent mass? I answer, *none*. Have no fear, make the experiment with confidence, pass the hand rapidly, but not too much so, in the metal in full fusion. If the experiment were performed with fear, or with too great rapidity, the repulsive force which exists in incandescent bodies might be overcome, and thus the contact with the skin be effected, so that harm and pain would result. To form a conception of the danger and pain there would be in thus passing the hand too rapidly into the metal infusion, it will suffice to recollect that the resistance is proportionate to the square of the velocity, and in so compact a fluid as liquid iron, this resistance increases, certainly, in a higher ratio. The experiment succeeds especially when the skin is humid; and the involuntary dread which one feels at facing these masses of fire almost always puts the body into that state of moisture so necessary for success; but by taking some precautions, one becomes veritably invulnerable. The following is what has succeeded best with me; I rub my hands with soap, so as to give them a polished surface; then, at the moment of making the experiment, I dip my hand into a cold solution of sal-ammoniac saturated with sulphuric acid, or simply into water containing some sal-ammoniac, and in default of that, into fresh water."

In explaining the theory of these extraordinary results, M. Boutigny says,—"I think that I have established, a long time ago, the fact that water in the spheroidal state has the property of reflecting radiating heat, and that its temperature never attains that of its ebullition; whence it follows, that the finger or the hand, being humid, cannot rise to the temperature of 100° Centigrade, the experiment not continuing long enough to permit the humidity to evaporate entirely. Indeed, there is *no contact* between the hand and the metal; this, in my estimation, is a fact positively established. If there is no contact, the heating can only take place by radiation; this is enormous, it must be acknowleged, but if the radiation is annulled by reflection, and it is so, it is as if it did not exist. To recapitulate

what I have stated; in passing the hand into any metal in fusion, it becomes isolated; the humidity which covers it passes into the spheroidal state, reflects the radiating caloric, and does not become heated enough to boil. This is all with reference to the spheroidal theory. I have often repeated the experiments with lead, bronze, &c."

In a later number of the *Comptes Rendus*, M. Boutigny details some further experiments.

"I moistened with water my forefinger, which I plunged into a bath of lead, when I experienced the same feeling of warmth which water gives in a spheroidal state. When I used alcohol for moistening my finger, the effect was the same; but when ether was used there was no sensation of heat, but, on the contrary, an agreeable feeling of coolness. I have repeated this experiment several times, and do not hesitate to declare that it is perfectly harmless, and that the most delicate female could do the same, not only without the least danger, but without the slightest inconvenience. But the finger should be plunged in as soon as it is moistened, and when the metal is perfectly liquid. It should be mentioned, that the portions of the hand which are not immerged in the fused metal, but are exposed to the action of the heat radiated from its surface, experience a painful sensation of heat." M. Boutigny then details some experiments by which he thinks that he proves that "bodies in a spheroidal state are surrounded by an atmosphere whose molecules are connected in such a way that it may be compared to a solid transparent envelop, of an infinitely small thickness and possessing very great elasticity."

THE HEAT OF COMBINATIONS.

EVERY molecular change in the condition of matter is almost invariably connected with the evolution or absorption of heat, and the quantity of heat thus set free or absorbed bears always a definite relation to the amount of the mechanical or chemical action. To ascertain this relation has been the object of my investigations, and the following are a few of my principal results. 1. The solution of a salt in water is always accompanied by an absorption of heat. 2. If equal weights of the same salt be dissolved in succession in the same liquid, the heat absorbed will be less on each new addition of salt. 3. The heat absorbed by the solution of a salt in water holding other salts dissolved is generally less than that absorbed by its solution in water. 4. The heat absorbed by the solution of a salt in the dilute mineral acids is generally greater than that absorbed by its solution in water. In reference to the combination of acids and bases, the heat developed during the union is determined by the base, and not by the acid. An equivalent of the same base combined with different acids produces nearly the same quantity of heat. When a neutral salt is converted into an acid salt by combining with one or more equivalents of acids, no disengagement of heat occurs. When a double salt is formed by the union of two neutral salts, the same is the case, but when a neutral salt is converted into a basic

salt, there is a disengagement of heat. When solutions of two neutral salts are mixed, and a precipitate formed from their mutual decomposition, there is always a disengagement of heat, which, though small, is perfectly definite in amount. The diamond disengages 7,824 units of heat during its combustion in oxygen gas, in the form of graphite, 7,778 units, and in that of wood charcoal, 8,080—*Dr. Andrews before the British Association at Birmingham.*

ACTION OF WATER ON LEADEN SERVICE-PIPES.

THE following extracts are taken from a very important investigation by Prof. E. N. Horsford, of Cambridge, published in the *Proceedings of the American Academy* for 1849. The researches were undertaken at the request of the Board of Consulting Physicians of the city of Boston, and must be considered as conclusive in regard to the long-agitated question concerning the action of lead on water:—"The waters used by man, in the various forms of beverage and for culinary purposes, are of two classes, viz.:—1. Open waters, derived from rain-falls and surface-drainage, like ponds, lakes, rivers, and some springs; and 2. Waters concealed from sunlight, and supplied by lixiviation through soils or rock, or both, of greater or less depth, such as wells and certain springs.

"They differ (*a*) in temperature; well-water, through a large part of the year, is colder than lake, pond, or river water;—(*b*) in the per-centage of gases in solution; recently drawn well-water, in summer particularly, parts with a quantity of air upon exposure to the surface temperature. In winter these relationships must to some extent be inverted, in high latitudes for a longer, and in lower latitudes for a shorter period. (*c*) They differ in the per centage of inorganic matter in solution; well-waters contain more;—(*d*) in the relative proportions of salts in solution; well-waters contain more nitrates and chlorides;—and (*e*) in the per centage of organic matter; well-waters contain less.

"*Relations of Lead to Air and Water.*—(*a*) Lead is not oxidated in dry air, or (*b*) in pure water deprived of air. (*c*) It is oxidated in water, other things being equal, in general proportion to the amount of uncombined oxygen in solution. (*d*) When present in sufficient quantity, nitrates in neutral waters are to some extent reduced by lead. (*e*) Both nitrates and chlorides promote the solution of some coats formed on lead. (*f*) Organic matter influences the action of water upon lead. If insoluble, it impairs the action by facilitating the escape of air; if soluble, by consuming the oxygen in solution, and by reducing the nitrates when present. The green plants, so-called, and animalculæ which evolve oxygen, are abundant in open waters in warm weather only, and of course when the capacity of water to retain air in solution is lowest; so that although oxygen is produced in open waters by these microscopic organisms, it does not increase the vigor of their action upon lead. (*g*) Hydrated peroxide of iron (iron-rust) in water is not reduced by

lead. Hence may be inferred the freedom from corrosion of leaden pipes connected with iron mains, so far as the reduction of the pulverulent peroxide of iron may influence it. (*h*) Alkaline chlorides in natural waters deprived of air do not corrode lead. (*i*) Salts, generally, impair the action of waters upon lead, by lessening their solvent power for air, or for other salts.

"A coat of greater or less permeability forms in all natural waters to which lead is exposed. The first coat (*j*) is a simple suboxide absolutely insoluble in water, and solutions of salts generally. This becomes converted in some waters into a higher oxide, and this higher oxide, uniting with water and carbonic acid, forms a coat (*k*) soluble in from 7,000 to 10,000 times its weight of pure water. The above oxide unites with sulphuric and other acids, which sometimes enter into the constitution of the coat *k*; uniting with organic matter and iron-rust, it forms another coat (*l*) which is in the highest degree protective. The perfection of this coat, and of the first above-mentioned, may be inferred from the small quantity of lead found in Croton water (New York) after an exposure in pipes of from twelve to thirty-six hours, and from the absence of an appreciable quantity in Fairmount water (Philadelphia) after an exposure of thirty-six hours, when concentrated to one two-hundredth of its bulk."

ANALYSIS OF THE WATERS OF THE DEAD SEA.

We find in *Poggendorff's Annalen* an analysis of a quantity of water from the Dead Sea, procured near the north end, not far from the mouth of the Jordan. The water contains :—

Chloride of Calcium	2.894
" Magnesium	10.543
" Potassium	1.398
" Sodium	6.578
" Aluminum	0.018
Bromide of Magnesium	0.251
Sulphate of Lime	0.088
Silica	0.003
	21.773

ARSENIC IN CHALYBEATE SPRINGS.

Since the discovery of arsenic in the deposits from certain chalybeate springs, it has been asked whether the poisonous properties of this substance are not neutralized by the state in which it is found. M. Lassaigne has finished a series of experiments connected with this subject, for the purpose of ascertaining the proportion of arsenic contained, in what state of combination it exists, and the nature of the action which these arseniferous deposits exert on the animal economy. The following are M. Lassaigne's conclusions :—1. In the natural deposits of the mineral waters of Wattviller, arsenic exists to the amount of 2.8 per cent. 2. A portion of these deposits, representing 1.76gr. of arsenic acid, or 1.14gr. of arsenic, produced no effect upon the

health of a dog. 3. This non-action shows that the poisonous property of the arsenic is destroyed by its combination with peroxide of iron, and thus confirms what has been before asserted, that peroxide of iron, by combining with arsenious and arsenic acid, destroys their poisonous properties, and consequently becomes an antidote for them.—*Journ. de Chim. Méd., Sept.*

FLUORINE IN THE WATERS OF THE FRITHS OF FORTH AND CLYDE, AND THE GERMAN OCEAN.

DR. G. WILSON has communicated to the British Association an article "On the Presence of Fluorine in the Waters of the Frith of Forth, the Frith of Clyde, and the German Ocean." In 1846 Dr. Wilson first announced the discovery of fluorine as a new element of sea-water. His mode of detecting it is to take the mother-liquor or bittern from the pans of salt-works, which derive their water from the sea, which he precipitates by nitrate of baryta. This precipitate, having been washed and dried, is warmed with oil of vitirol in a lead basin, covered with wax, having designs on it, which in two hours were etched as deeply as they could have been by fluor spar treated in the same way. Till the present year, however, Dr. Wilson had only examined water from the Frith of Forth, but he has now pursued his experiments, and finds that the indications of fluorine are much less distinct in the Frith of Clyde than on the east coast, but he easily detected it in the crust collected in the boilers of steam vessels. This crust consists in a great measure of sulphate and carbonate of lime, and carbonate of magnesia, but there is also chloride of sodium and other salts. By examining the deposit in boilers of steamers navigating the German Ocean, he has also there detected fluorine, and it may therefore be inferred, that, as fluorine exists in these three localities, it exists in sea-water generally, which is a conclusion to which others have previously been led by various circumstances. Dr. W. has also detected fluorine in the teeth of the walrus, which indicates its existence in the Arctic Ocean, and its invariable presence in the corals collected by the United States Exploring Expedition points to its existence in the Antarctic Ocean, while it has also been found in kelp from the Shetlands.—*London Athenæum, Sept.* 15.

CARBONATE OF LIME AS AN INGREDIENT OF SEA-WATER.

MR. J. DAVY read before the Royal Society of London, at its meeting, June 14th, an interesting paper on the question, whether carbonate of lime exists in all sea-water. The author has made several experiments upon the water of the ocean in crossing the Atlantic, which go to show that carbonate of lime is not widely diffused through the ocean, but exists as an ingredient of sea-water near the land, and in other situations, where its presence is very easily accounted for, and where, in the economy of nature, it may be supposed to be useful. Mr. Davy has also made some trials on sea-water in relation to the sulphate of lime it contains, which is found to vary in quantity in different

situations. He suggests the propriety of further inquiry upon this subject, as the results may be important in connection with steam-navigation, the injurious incrustation, which is liable to form in boilers at sea, being composed chiefly of this substance.—*Brewster's Magazine, Sept.*

ON THE EXISTENCE OF MANGANESE IN WATER.

AT a meeting of the American Academy, in January 1849, Dr. Charles T. Jackson stated that he had discovered the presence of manganese in the water of streams, lakes, &c., almost universally. He had detected it in water from the middle of Lake Superior, in Cochituate water, and in water from various sources. It has usually been regarded as iron in previous analyses. He considered the observation as having an important bearing in accounting for the deposits of bog manganese at the outlets of ponds, lakes, and in bogs, as well as for the source of the oxid of manganese in the blood.

ON THE PRESENCE OF ORGANIC MATTER IN WATER.

THE following facts relative to the presence of organic matter in water were presented to the British Association, by Professor Forchhammer, as the result of extended observations on the waters near Copenhagen. 1st. The quantity of organic matter in water is greatest in summer. 2d. It disappears for the most part, as soon as the water freezes. 3d. Its quantity is diminished by rain. 4th. Its quantity is diminished if the water has to run a long way in open channels. The hypermanganate of potash or soda is recommended by the Professor as a most excellent test for the presence of organic matter in water.—*Athenæum, Sept.* 22.

PROBABLE CAUSE OF GOITRE AND CRETINISM.

M. GRANGE has sent to the Paris Academy of Sciences a paper containing the results of numerous analyses of waters from the talcose, anthraxiferous, and cretaceous formations of the valley of Isère, in Switzerland. The investigations were made at the suggestion of M. Dumas, the celebrated French chemist, with a view of ascertaining the relative quantities of chlorides, sulphates, and carbonates contained in the waters from the glaciers down to the plains, and of comparing together the salts dissolved in the waters of the different formations. The locality, as has been stated, was the mountains in the valley of Isère, some of which attain the height of 3,000 metres.* The investigation shows,—1st. That the quantity of dissolved salts increases from the summit of the mountains towards the plain. 2d. That in the talcose and anthraxiferous formations the chlorides of sodium and magnesium, and the sulphates of soda, lime, magnesia, and potassa, diminished relatively to the total mass of salts as we descend from the summits, and form 25 to 30 per cent. of the dissolved salts; the sulphates forming from 24 to 31 per cent., and the carbonates from 36 to 47 per cent. 3d. That in the anthraxiferous formations the sul-

* A metre equals 39.37 inches.

phates of soda, lime, and magnesia exist in greater quantities than in the talcose formation. 4th. That in the cretaceous formations the chlorides and sulphates diminish, and the carbonates of lime and magnesia increase.

Having obtained these results, M. Grange says that he thus finds that magnesia exists to the amount of 10 to 15 per cent. of the total amount of the salts in the waters of the villages and valleys where goitre and cretinism are endemic. In addition to his own observations, he has gathered from other sources proofs that, in Switzerland, Piedmont, the Vosges, Pyrenees, and all other places where the goitre and cretinism prevail, similar rocks exist, which would give rise to a similar quantity of magnesia in the water. "It follows, then, that if the waters be, as is generally believed, the proximate cause of goitre and cretinism, we may refer the deleterious action of the waters to the salts of magnesia, or perhaps to the presence of these and the absence of a sufficient quantity of lime for the wants of the animal economy."

M. Billet has lately published a paper in confirmation of these views of M. Grange. He details many facts with great minuteness, tracing the goitre even to the water of particular springs in some villages. He also gives some statistics of goitre and cretinism. Among the 176,000 inhabitants of the Diocese of Chamberry, 1,187 have one or both of these diseases. In the diocese of Maurienne the number is 5,587, out of 63,156 inhabitants. Among the 1,187 diseased persons in the diocese of Chamberry, there are 818 having goitre alone, 163 cretinism alone, and 206 having both. In that of Maurienne, there are 4,010 cases of goitre alone, 296 of cretinism alone, and 1,281 of both united. Of the 818 persons in the diocese of Chamberry who have goitre alone, there are 515 females and 303 males. In the diocese of Maurienne, 2,170 females to 1,840 males have the goitre alone. Thus females are clearly most liable to the goitre, and among other reasons given for this is the fact that they drink more water and less wine than the males. The cretins are about equally divided between the two sexes, there being in Maurienne 785 females and 783 males. The goitre develops most between the ages of 8 and 15 years, and but few cases commence at a later period.—*Annales de Chimie*, Vol. XXVI. p. 129.

ON THE PRESENCE OF COPPER IN THE HUMAN BLOOD.

We find in the *Journal de Chimie et de Pharmacie* an article by M. Deschamps on the presence of copper in the human blood. The author states that he came to the conclusion to reject all previous experiments, as being indecisive on account of the want of precision and care in making them, and he therefore commenced a series of careful observations. After considering the different processes proposed for the detection of metallic substances in the blood, he adopted one analogous to that which he employed to extract copper from vegetables. The acids and distilled water used contained no metallic substance whatever, the hydrochloric acid being prepared expressly for the purpose. The filters were made of paper which was analyzed and found to contain no copper, and they were washed with concentrated nitric

acid, diluted with an equal volume of distilled water. The capsules, crucibles, tubes, and all the instruments employed, were also washed with nitric acid. The blood was carefully evaporated to dryness in a porcelain capsule, and burnt in a crucible; the ash was treated with nitric acid; the solution was evaporated to get rid of the greater part of the acids, then treated with water, filtered into a bottle, subjected to the action of hydrosulphuric acid in a small porcelain capsule, treated with a few drops of aqua regia, and allowed to stand till the precipitate became of the color of sulphur. When analyzed, it had all the properties of a salt of copper. The author therefore thinks that the existence of copper in the blood cannot be questioned.

THE AIR AND WATER OF TOWNS.

In the Proceedings of the British Association we find an interesting report by Dr. Smith, on the air and water of towns. The author, after remarking on the general and well founded belief that the air and water have a most important influence upon health, proceeds to examine all the sources from which the air and water of towns can be contaminated, and the changes which are caused by them. If air be passed through water, a certain amount of the organic matter poured off from the lungs is to be detected in it. By continuing this experiment for three months, Dr. Smith detected sulphuric acid, chlorine, and a substance resembling impure albumen. These substances are constantly being condensed upon cold bodies; and in a warm atmosphere the albuminous matter very soon putrefies and emits disagreeable odors. By oxidation this substance gives rise to carbonic acid, ammonia, sulphuretted hydrogen, and probably to other gases. By collecting the moisture of a crowded room by means of cold glasses, and also dew in the open air, it was found that the former was thick and oily, capable of decomposition and productive of animalcules, while the dew was beautifully clear and limpid. Large quantities of rain-water have been examined by Dr. Smith, and he says, "I am now satisfied that dust even comes down with the purest rain, and that it is simply coal-ashes." The rain-water of Manchester is considerably harder than that from the neighbouring hills. This can only arise from the ingredients obtained in the town atmosphere; but the most curious point is the fact, that organic matter is never absent, although the rain continues for several days. The state of the air is closely connected with that of the water; what the air contains the water may absorb, and what the water has dissolved or absorbed, it may give out to the air. Dr. Smith has examined many wells in Manchester, and he finds nitrates in all of them; in some they exist to a surprising extent, so that they are very nauseous. It was discovered that all organic matter in filtrating through the soil is very rapidly oxidized. The nitrates are also found in the London water, and prevent the formation of any vegetable matter, so that none can be detected, even by the microscope, after a long period. In summing up the results obtained, Dr. Smith remarks that the pollution of air in crowded rooms is really owing to organic matter, and not

required for purification became perfectly innocuous. In the latter operation, the lime employed caused the bisulphite to disappear by neutralizing it, leaving the juice purified and free from fermentatives, and from all matters capable of producing them. The juice thus prepared was ready for evaporation without any loss of sugar.

"But the bisulphite of lime was soon discovered to possess other qualities of a peculiar character. With the antiseptic property, and the property of absorbing the oxygen gas of air, it unites the properties of a powerful purifier. Heated to 100°, French measurement, it separates the albumen, the caseine, and matters containing nitrogen, all of which are found to exist in a natural state in saccharine juice. The separation is effected without loss, and without any appreciable transformation of the sugar. It remained to be ascertained how far the bisulphite was effective in opposing the coloring of saccharine liquids. The coloring of the saccharine juices of the cane proceeds from four principal causes:—1. The cane itself contains colored matter, which becomes dissolved in the juice. 2. The contact of the juice with the air rapidly engenders colored substances, which unite with the preceding. 3. The heat employed in evaporating, by altering a part of the sugar and of the products which accompany it, also forms coloring matter. 4. The contact of the air and of the lime, and also of the ammoniacal gases, assisted by the action of the heat, produces coloring matter during the evaporation of the juices when alkalized by lime.

"The bisulphite of lime almost instantaneously extracts the color of the colored matter which exists in the cane from natural causes; it prevents the formation of the colored matter which the air produces by its contact with the juice; and prevents the production of that which is engendered during evaporation, and especially of that which requires for its formation the concurrence of the air and of a free alkali. The effect attending the use of the bisulphite, as an agent capable of resisting the formation of color, is so remarkable as to deserve the attention of persons employed in many branches of the productive arts. There is no doubt that the cases are numerous in which it can be employed in the most efficacious manner, in preventing the formation of those coloring matters, which, when once formed, it is found so difficult to destroy or extract. Such matters, for instance, are those which color hemp-yarn and flax, indigo after precipitation, the juice of barks used in tanning, and the extracts of certain dye-woods.

"Meanwhile, Melsens has established that, in the process of evaporating without the application of artificial heat, the presence of the bisulphite effectually opposes the formation of coloring matter, and that where the evaporation is effected by the application of artificial heat, the coloring matter formed is scarcely perceptible.

"Although we have omitted many details, we have exhibited enough to show that bisulphite of lime can be employed in the operation of extracting sugar from the cane,—1. As an antiseptic of superior excellence, preventing the production and action of fermentatives of whatever kind. 2. As an agent absorptive of oxygen, capable of

preventing the alterations occasioned by the presence of the latter in the juice. 3. As a purifying agent, which, at 100 degrees, will clarify the juice and separate from it all albuminous and coagulating substances. 4. As an agent capable of expelling preëxisting colors. 5. As an anti-colorant, capable of effectually preventing the formation of coloring matter. 6. As an agent capable of neutralizing the injurious acids which may be found existing, or may be engendered in the manufacture.

"The questions that next presented themselves for investigation were, in what proportions, and under what forms, the bisulphite of lime should be applied,—what inconveniences, balancing its promised advantages, might attend its use. To enable himself to answer these questions satisfactorily, Melsens procured from the province of Murcia, in Spain,—where for ages sugar from the cane has been manufactured,—a quantity of ripe canes. They reached Paris in good condition, and were deposited in the laboratory of the Sorbonne, where the experiments were being prosecuted. A number of persons conversant with the manufacture of sugar in the colonies were present at the first essays. The results were such as to fill them with surprise. The juice was extracted by crushing the cane in a common mortar previously supplied with the bisulphite. It was purified by ebullition, and then passed through a piece of cloth. The syrup, after being concentrated and filtered a second time, was left to slow crystallization. The sugar obtained by this simple process was as excellent in quality as could have been obtained by the use of alcohol.

"The experiments tried in Paris upon the cane-juice demonstrate that the employment of the bisulphite secures the extraction of all the sugar contained in the cane, and produces it in a solid and crystallized form. The crystals are large and firm: they are not more colored than common candy, of which they have the appearance, and they exhibit no appreciable traces of the slightest alteration being effected in the saccharine properties. If, therefore, we take into consideration the almost absolute purity of the cane-juice,—which is in reality nothing but sugared water,—when purification has once been effected, and if we also take into consideration the special aptitude of cane-sugar to assume the form of large crystals, it would seem almost certain that the first planter who will submit a quantity of syrup to slow crystallization, by Melsens' method, will obtain crystals exceeding in size and quantity, and excelling in whiteness and appearance, all previous experience.

"But we have not done with the advantages that will attend the introduction of this new agent. It is well known that the juice extracted from the cane by means of pressure is but a small proportion —sometimes only a half, and at most two-thirds—of what might be extracted. There remains, therefore, behind, a third or more of the natural yield of the sugar-crop, and this third becomes, we believe, a total loss. The extraction of the sugar, thus wasted, by simply washing with pure water, is not to be thought of. The air, the heat, the fermentatives, and other causes, contribute to establish a

rapid fermentation, and no gain can be derived from the operation. But by Melsens' process the difficulty and waste are obviated. With water containing a small quantity of the bisulphite, not only may the washing be effected with ease, but at the leisure of the planter. Hours or days, at his will, may be employed in this operation, now, perforce, neglected altogether. The saccharine washings will be found nearly as rich in sugar as the juice proves, and if treated in the same manner, by purification, by simple filtration, and by concentration in the free air to the consistency of syrup, crystallization will ensue with equal certainty and success, the product being in all respects similar and equal to that obtained from the juice itself.

"A comparison of the methods actually in use, in the extraction of sugar from saccharine juices, with that prescribed by Melsens, will assist in the formation of a correct appreciation of the superiority of the latter.

"By the present methods, the crushing being operated under exposure to the air, the alterations attending it render rapidity of execution indispensable. But, however rapid the execution may be, it does not, and cannot, prevent alterations from taking place. Again, the purification effected by means of lime develops and stimulates the formation of coloring matter, and compels the employment of animal black. Finally, the process of evaporation, which is effected at a high temperature, modifies a portion of the sugar which the heat renders uncrystallizable. From this results the necessity of resorting to repeated operations, and to four or five successive crystallizations, which are never completely productive. Melsens' method, on the other hand, allows of ample time, dispenses with animal black, and effects the production of the solid sugar by a single crystallization.

"The present product of a hundred pounds' weight of sugar-cane does not exceed nine pounds' weight of sugar, whereas the natural contents are about eighteen, the whole of which may be extracted by the new method. Introduced into this country, it will prove only second in importance to Whitney's cotton-gin. It will increase the culture of the cane and the manufacture of its precious secretion. With the lessened cost of production, the price to the consumer must also be lessened."

Since the announcement of the discovery of Melsens in this country, the process has been repeated by various persons on the sugar plantations of Louisiana with perfect success.—*Editors.*

THE DISCOVERY OF M. MELSENS.

In addition to the above description of M. Melsens' discovery, we subjoin the following interesting statement, given by himself, of the origin of the discovery and the confirmatory experiments undertaken by him. After speaking of some previous investigations, he says,—"Three substances particularly fixed my attention: the binoxide of azote, sulphurous acid, and aldehyde. This remarkable class of compositions, having a great affinity for oxygen, and which contain already two equivalents of this body, and absorb a third with facility

to produce acids, appeared to me eminently proper to fulfil one of the conditions mentioned, viz., to prevent by their presence the oxygen of the air from acting in producing fermentation.

"I have no doubt but that some one more capable than myself will ultimately succeed in giving a practical form to the binoxide of azote, for I cannot believe but that a substance which destroys instantly oxygen, and forms with it an acid proper to precipitate the fermenting matters, will be one day employed in the extraction of sugar. Dissolved in the sulphate of iron, it would guarantee the juice from all alteration until the end of the purification by lime, and this accomplished, the juice would retain scarcely a trace of the reagents employed.

"Aldehyde, or the organic substances which resemble it, are too dear. I therefore made no stop at them.

"During all the experiments which I slightly mention, I found myself always inclined to return to the use of sulphurous acid; its efficacy as an obstacle to fermentation is so well proved, its price is so low, its production so easy, and the substances necessary to produce it so universal. It is true, that sulphurous acid, which was so successful in the hands of Proust when used to prevent fermentation in the saccharine matter of grapes, has always presented, when applied to the manufacture of beet-sugar, insurmountable objections. I was not ignorant, either, that the most experienced persons had failed in the attempt to use it. Nothing practical had resulted from their efforts.

"If sulphurous acid can be profitably used where the must of grapes is concerned, if in preventing fermentation it has no influence on the sugar, it is because it possesses at once these properties either of itself, or because it is converted into sulphuric acid by the action of the air. Every one knows, on the contrary, that the cane-sugar is changed, and takes the nature of grape-sugar, when placed in contact with acids, particularly with sulphuric acid. Thus, however inoffensive the sulphurous acid is when applied to the must of grapes, it is impossible to use it for the juice of the sugar-cane or the beet; for as soon as the air absorbed by the sulphurous acid changes it into sulphuric acid, the effect of this last on the juices mentioned changes them into grape-sugar. Reflecting on this difficulty, I asked myself if sulphurous acid used with a powerful base such as potash, soda, or lime, would still present this obstacle. I found, in reality, that the base, absorbing the sulphuric acid as soon as formed, left the sugar intact. From this point I was led to make many experiments, easy to reproduce, useless to repeat in detail, and which I will sum up in a few words.

"Dissolved sulphurous acid added to a solution of the juice of sugar-cane, or beets, prevents fermentation, but destroys slowly the sugar if left cold in contact with the air. If heated, the destruction is much more rapid. The neutral sulphites of potash, of soda, and of lime, do not prevent fermentation, but do not injure the sugar, whether cold or warm. Neither of these products, then, would serve. The acid sulphites, and more especially the sulphite of lime, presented, on

the contrary, properties worthy of interest. Sulphurous acid, in excess, prevents all fermentation. The base which all these salts contain neutralizes the sulphuric acid as fast as it is formed. It remains to be seen if, by themselves, or by their excess of sulphurous acid, they have or not the power to convert cane-sugar into grape-sugar. I have heated, for several hours, small quantities of sugar-candy, dissolved in water, with a large quantity of bisulphite of lime. The sugar was changed. It became uncrystallizable and deliquescent. The syrup thus formed presented sometimes an appearance with which manufacturers of sugar are well acquainted. Submitted to the action of heat for evaporation, it remained motionless. There was, therefore, the proper quantity to find out, and much care to be taken; but as it takes a great deal of the bisulphite of lime to destroy the sugar, and a small quantity to destroy fermentation, I thought this agent worthy of a closer examination. Sugar-candy in cold water, charged with bisulphite of lime, even in excess, crystallizes without loss and without change, by spontaneous evaporation, at a very slow heat. It is, therefore, possible to manufacture sugar without artificial heat. Perfectly white sugar candy being dissolved in ten times its weight of water, I added half its weight of a solution of bisulphite of lime, marking ten degrees of the areometer of Baumé, and boiled it for about an hour. It was then filtered, to clear it of the neutral sulphite, which was deposited. It was afterwards put into a plate, where it crystallized entirely without a trace of molasses, leaving precipitated, however, a small quantity of the tartrate of copper, which had been dissolved in the potash. Straw-colored sugar-candy, treated in the same way, gives the same result, only that the crystals are lighter-colored than the candy itself. The same experiment with all kinds of sugar produced the same results, whether the liquid, when evaporated, was left acid, or had been carefully neutralized after boiling. I found, also, that the crystallization was as perfect and rapid when the liquid was left unfiltered, as when it was filtered before the evaporation."

POTATO-SUGAR.

It is not generally known to how great an extent the manufacture of sugar from fecula, or starch, is carried on in France. The mode of proceeding is to have large leaden boilers, in which is one ton of water, heated to a boiling point, and to this twenty-two pounds of sulphuric acid at 60°, diluted with twice its weight of water, is added. The vessel is provided with a wooden cover, coated with copper, which has a small opening to allow the liquor to be stirred with a wooden rod. After the liquor begins to boil, eight hundred-weight of starch flour is gradually sifted into it, care being taken to prevent the formation of lumps and to have the boiling uniform. In some factories the starch is first mixed with water, and placed in a vessel above the water, and made to flow into the boiling acid in a uniform stream by a tube. The boiling is continued about fifteen minutes after the starch is put in, and then the fire is so regulated that the liquor ceases

to boil, after which twenty-two pounds of chalk are added to neutralize the free acid: but this must be put in very slowly, on account of the violent evolution of the carbonic acid set free by the new combination, which produces sulphate of lime. The liquor is then strained through coarsely pulverised bones spread on straining-cloths. The filtered liquor is gradually brought into flat pans and evaporated till it is reduced to half its volume, when it is a second time boiled, with charcoal and bullock's blood, and then refined and filtered. One hundred parts of dry starch yield about one hundred parts of sugar, which is obtained by concentrating the syrup and putting it into casks, where it is left to cool. After two days crystallized sugar is found in the casks, with some liquid, which is drawn off. Thus by the aid of chemistry we obtain sugar from potato-starch, sulphuric acid, chalk, and water. This sugar is used for giving more "body" to the Burgundy wines, and for confectionery. It is known chemically as grape-sugar.

PRODUCTION OF SUGAR IN THE URINE BY WOUNDING THE BRAIN.

An important and entirely unexpected discovery made recently by M. Bernard has been announced to the French Academy. He has found that by wounding a certain part of the floor of the fourth ventricle, the composition of the urine becomes altered, and sugar makes its appearance in it. The puncture is made by passing the instrument through the inferior orifice of the ventricle, and soon afterwards the urine of the animal (a rabbit), which before the operation is turbid, alkaline, and free from saccharine matter, becomes abundant, clear, and contains in solution a very large quantity of sugar, and resembles that of a diabetes. In general not more than an hour and a half or two hours are requisite for the complete production of this change in the characters of the urine. The blood also contains a large amount of sugar. The experiments have hitherto been made upon sixteen rabbits; and by varying them, M. Bernard has found that the point of the fourth ventricle which must be wounded to produce this remarkable phenomenon of the appearance of sugar in the blood and urine is very limited, and corresponds to a space situated a little above the origin of the eighth pair of nerves. These results, which are so surprising from their novelty, cannot at present be in any way explained. They merely serve to show the remarkable influence which the nervous system exerts upon the functions of nutrition; and in this light they deserve the serious attention of chemists.

ON THE ORIGIN OF SUGAR IN THE ANIMAL ECONOMY.

It has been generally maintained that sugar exists in the blood of animals only when they have previously eaten substances containing it, or capable of being converted into it,—the economy having, in fact, been most explicitly denied the power of making sugar, its sole province being that of destroying it and causing its disappearance. As sugar is found in the blood after the digestion of amylaceous and saccharine substances, it has been hastily assumed that its existence is

due to the use of these descriptions of aliment. Experiments performed by Dr. Charles Bernard prove, however, *that sugar is found in the blood in all alimentary regimens, and even after long abstinence, and that the origin of this sugar in animals fed on meat alone, or subjected to long abstinence, must be in the liver.* In this organ it becomes mixed with the blood, and is carried by the vena cava inferior and the suprahepatic veins to the right side of the heart, where it is constantly found. An examination of sugar produced from the blood or liver proves that it is neither cane-sugar nor sugar of milk, but it presents all the chemical characters of grape-sugar or *glucose.*

But how is the sugar thus found produced? Does it result directly from a peculiar transformation of certain elements of the liver, or is it derived from external alimentary substances deposited or accumulated in this organ? As it might be said that animals fed on meat, or kept fasting, had, prior to the experiments, partaken of food which supplied the sugar in question, examination of the blood and liver was made in those which had been so kept for ten days, and yet the sugar was found; while, on the other hand, this was quite absent in other animals which had been fed on saccharine articles of food, and in which the pneumogastric nerves on both sides were divided. The quantity of sugar found in the liver and blood of different animals varies. Dr. Bernard's observations, however, allow him to affirm, that in birds (fowls and pigeons) the proportion is very considerable, as it is also in mammalia (dogs, rabbits, pigs, oxen, horses, &c.) In reptiles (frogs and lizards) it is very slight, while in fishes no traces are found, thus indicating that the absence of sugar in cold-blooded animals depends upon the inferior energy of their respiratory functions.

THE COMPOSITION OF HONEY.

It has long been known that the honey of the bee contains two different sugars, one of which is solid, and the other liquid. The former is considered as identical with the granular sugar, which is slowly deposited from the syrup of raisin-sugar, or in that of cane-sugar altered by acids. As to the liquid part of the honey, it has been but little studied, though M. Biot has stated that it is a sugar which turns the rays of polarized light to the left. M. Soubeiran has been engaged in making some investigations into the composition of honey, and, after detailing his experiments, arrives at the following results. Honey is composed of a mixture of three different sugars; one is the granular sugar; another the liquid sugar, which resembles in many particulars cane-sugar altered by acids, but is distinguished from it in possessing a much stronger rotary power towards the left. The liquid sugar of honey retains its rotary power towards the left even after it has been rendered solid; it is one of the few substances which possess this character. The third sugar which constitutes part of honey is distinguished from granular sugar in being unalterable by acids, and from liquid sugar in rotating towards the right. Its proportion is considerable in honey from the comb, but diminishes by keeping, and even entirely ceases to exist in solidified honey.—*L'Institut.*

A PECULIAR FIBRE OF COTTON WHICH IS INCAPABLE OF BEING DYED.

Mr. W. Crum describes, in *Brewster's Magazine* for November, a peculiar fibre of cotton, which is found to resist the usual processes for dyeing, and thus to leave white spots in the cloth. Such spots have long been noticed and dreaded by calico-printers, who call the cotton of which they are formed *dead cotton.* The ordinary cotton fibre is a tube originally cylindrical, which collapses in drying. On placing a few of the fibres of the "dead cotton" under the microscope, Mr. Crum found them to consist of very thin and transparent blades, some of which are spotted, while others are so clear as to be almost invisible. These fibres are readily distinguished from those of ordinary cotton by their perfect flatness, and their uniform as well as great transparency. They are often broader, show numerous folds, but are never twisted into the corkscrew form of the ordinary fibre. We must suppose that these flat fibres, like the healthy unripe cotton fibre, were originally tubes filled with liquid, but that the seed around which they began to grow had died while they were yet soft and pliable, and that the flattening was caused by the pressure from the increasing crop of cotton attached to the numerous other seeds confined in the same pod. The fact of the existence of such fibres in cloth has a considerable bearing upon the disputed point, whether cotton-wool and coloring matters form together a true chemical compound, or are held together by a merely mechanical power, and is a strong argument in favor of the latter view.

INCOMBUSTIBLE CLOTH.

At the meeting of the British Association in September, 1849, Sir David Brewster exhibited several specimens of printed calico which had been rendered incombustible, by immersion in a solution of phosphate of magnesia. When inflamed it soon went out without the fire spreading. Sir David Brewster stated that a spark or red coal would not ignite it.

PREPARATION OF INDIGO AS A DYE.

In the use of indigo for dyeing, as it is insoluble in most menstrua, a preliminary process is necessary to bring it into the proper state for use. This is now effected by exposing it to the action of bodies having a superior affinity for oxygen, or by mixing it with some organic matter containing sugar, mucilage, and other fermentable materials, or by subjecting it to the solvent power of sulphuric acid. When fermentable materials are used, wood and bran of wheat are commonly employed, but within a short time a patent has been taken out for substituting as the fermenting material the young shoots of the common carrot and of the parsnip prepared in the following manner. To prepare a vat, take of the stems and leaves of the common pars-

nip or carrot 4,480 pounds, and pass them through a crushing machine, or otherwise reduce them to a high degree of pulverization, and throw them into a heap upon a suitable floor in a warm room, stirring the mass once a day for three weeks, or until fermentation has taken place throughout the whole. Next add a pint and a half of alkali (or of a combination of fifteen parts of lime to one of sal-ammoniac) to every two hundred pounds of the material, and thoroughly incorporate it with it, stirring it over occasionally until the acid fermentation has become neutralized. The compound is then fit for use, but improves by age.—*Patent Office Report for* 1848.

A SIMPLE AND CERTAIN TEST OF THE QUALITY OF INDIGO.

REINSCH tried various modes of determining the goodness of indigo, but none of them gave results to be relied on till "at last," he says, "I resorted to fuming sulphuric acid, and obtained the most satisfactory results. It is necessary, however, that the indigo should be pounded very fine, and the acid should be as concentrated as possible. The mode in which I proceed is as follows:—One tenth of a gram* of each sample of indigo is well pounded, mixed with four or five drops of fuming sulphuric acid, and rubbed with it till the whole forms a brown uniform mass. To this one gram of sulphuric acid is added, and triturated till it produces a clear green solution, whereupon another gram of fuming sulphuric acid is added; lastly, this solution is gradually mixed with ten grams of water. Two glass cylinders of equal width and length are now divided each into twenty equal parts, and one gram of the sulphuric solution poured into one and mixed with water, till the solution is of a light blue color and transparent; if one gram of the solution does not produce sufficient coloration, a small quantity more of it is added, till the cylinder is filled with the light blue solution. I generally commence with the apparently best indigo. After this, the second cylinder is filled in the same way with an equal quantity of the same indigo sample and water, in order to see whether the two solutions are equal in color. If this be the case, one of the cylinders is emptied, and an equal quantity of sulphuric acid solution of an inferior sample poured into it, and gradually diluted with water, till the solutions in both cylinders are perfectly alike in color. Care must be taken to have both solutions of exactly the same hue, and as soon as this is accomplished, the quantity of water which has been poured into the second cylinder is examined. Supposing now that one gram of sulphuric acid solution has been employed in both of the cylinders, but the quantity of water which produced the equal color was in the first or standard cylinder twenty parts, and in the second only fifteen parts, then the sample of which the latter solution was made will contain one quarter less of coloring matter. For some reason the Java indigo and that chemically prepared by treating it with acid, caustic potash, &c., do not give the desired results, and I therefore used Bengal, first quality, which excelled all others in coloring capacity, and contained at least fifty per cent. pure coloring matter.

* A gram equals nearly 15½ grains Troy.

"I have yet to add some observations with regard to an adulteration practised on the indigo. Each large indigo-chest contains a quantity of dust, which is said to amount sometimes to eight or ten pounds. This dust is an artificial product, composed of starch, or white lead, and powdered indigo, and is put in the chest in order to increase its weight. The finest Bengal indigo is to be preferred to the finest Java at the same price, but Bengal No. 2 is nearly as good as No. 1, and its price is one third less, while Bengal No. 3 is sold at half the price of No 1, but is worth as dyeing material only one third as much."—*Jahrbuch für praktische Pharmacie.*

NEW METHOD FOR THE DETECTION OF IODINE.

THE detection of small quantities of iodine is one of the most difficult processes in chemistry, and any new and accurate mode will be at once welcomed. We find in the *Journal de Chemie M:dicale* for Sept., a process by M. Thorel. It is a modified manner of using starch. Put into a small phial 50 or 60 grams of the suspected liquor, or if it be a solid body, diffuse it in a small quantity of water; add six drops of pure nitric acid and as much hydro-chloric acid; a small piece of paper is then to be covered with a rather liquid preparation of starch, and placed at the mouth of the phial, which is to be heated. If the liquor contains iodine, the paper will assume a violet blue tinge, of greater or less intensity. The nitric acid sets the iodine free by decomposing the iodides, if any exist; the effect of the hydro-chloric acid is, that it is substituted for the iodine by decomposing the iodate. If the paper should not become colored at the moment of ebullition, the same quantity of the two acids should be added, shaking the phial strongly. In an instant the spots should appear, and the stratum of iodine will gradually increase. It must not be immediately concluded that no iodine is present, if no color appears, for it is separated with difficulty from some bodies, such as molasses. In such cases a second operation must be performed, adding to the liquor 10 to 20 centigrams of tartrate of potash dissolved in a small proportion of water. Heat is to be applied an instant before the addition of the acids, which, on this occasion, may be used in the proportion of 8 to 10 drops of nitric acid, and 4 drops of hydro-chloric acid. After this trial an opinion may be arrived at with great certainty, as exceedingly minute quantities of iodine are thus detected.

A NEW TEST FOR ALBUMEN.

WE find in the *Comptes Rendus* for Jan., an interesting paper by M. Millon on a new test for albumen. He says that the highly acid liquid obtained by dissolving mercury in its own weight of nitric acid constitutes an extremely delicate reagent for albumen and albuminous compounds. This mercurial solution communicates to albuminous substances an intensely red color, by means of which

a very minute portion of albumen in water may be detected. To give an idea of the delicacy of this reagent, and to show its applicability to the study of vegetable organization, it may be stated that starch and gum acquire by its action a very distinct rose-color. Urine almost always becomes of a rose tint after the nitro-mercurial solution has been mixed with it, and the mixture been warmed. The albumen of the blood, that of plants and fibrine, gluten, legumine, silk, wool, feathers, horn, epidermis, and gelatine are equally affected. This mercurial solution is more readily prepared by dissolving mercury in its weight of nitric acid in the cold. When reaction has ceased, a gentle heat may be applied to facilitate the solution of metal. When the solution is complete, the liquid should be diluted with two parts of distilled water by measure, and after some hours the liquid is to be decanted from any mixed crystals of nitrate and nitrite of mercury which may subside. This reagent acts on albuminous substances at low temperatures, but not so completely as at a temperature of from 140° to 150° Fahrenheit, and it is even preferable to continue the application of heat to the boiling point. The prolonged action of the reagent in excess does not alter the red matter, as has been ascertained by the contact of albumen with this solution for over a year. According to M. Millon, this singular property of giving a pink or red color to albuminous substances resides neither in the nitrate nor in the nitrite of mercury, nor in their mixture. It is necessary that there should be hyponitrous acid in the solution which contains the two salts. The pure pernitrate of mercury saturated with hyponitrous acid forms a delicate reagent, but inferior to that of a saturated solution of the mixed salts. One or two drops of this solution are sufficient for the detection of albumen, which has been thus detected in the liquid of cholera when nitric acid and heat have failed to demonstrate its presence.

TO DETERMINE THE QUANTITY OF PHOSPHORIC ACID IN SOILS.

THE *Journal of the Franklin Institute* translates from the *Comptes Rendus* for Jan. 22 the following "Method of Determining the Quantity of Phosphoric Acids in Soils by Means of a Normal Liquor." This method is based, first, upon the property possessed by solutions of potassa and soda of transforming, at a boiling temperature, insoluble phosphates into the soluble phosphates of these bases; and secondly, upon the property possessed by nitrate of silver of precipitating these phosphates, by forming a phosphate of silver, which is the more easily and clearly deposited, as the precipitation is more nearly complete, which allows the moment when the reaction has ceased to be readily determined. The following is the manner of operating. The phosphoric acid of the compound to be examined having been precipitated in an insoluble form, a known weight of these insoluble salts is boiled with four times its weight of carbonate of soda, dissolved in from eight to ten times its bulk of distilled water. The liquid is filtered to separate the insoluble carbonates and other salts, and the

filter twice washed with boiling distilled water. The filtered liquids are then well mixed and divided into two exactly equal portions, which are separately introduced into two small matrasses. To these liquids is then added, little by little, a test liquid so made that each cubic inch represents a known quantity of nitrate of silver. After every addition the liquid is to be shaken, and the additions are continued until when left at rest it becomes clear, and this will only take place when the saturation is perfect. The proper precautions must of course be taken to prevent precipitating the chlorides and sulphates with the phosphates. The phosphate of silver can always be reconverted, so that the expense of the operation is very small.

INORGANIC CONSTITUENTS OF THE OAT PLANT.

A recent chemical journal contains the records of a series of interesting experiments on the necessary inorganic constituents of the oat plant. Single grains were sown in pure charcoal, prepared from sugar, contained in little tin vessels lined with wax. Without the addition of any thing to the charcoal a plant was obtained, but it was very small and sickly. Ammonia salts alone produced a plant of a lively green color, but still small and weak; increase of these salts in a second and third experiment killed the plant. A mixture composed of silicate of potash, carbonate, sulphate, and phosphate of lime, produced a plant of double the size. On adding to this mixture an ammonia salt, the weight of the plant was quadruple that of the last, but still weak for want of iron, as another experiment proved. On the addition of oxide of iron to the mixture, a much finer plant was obtained, but withered spots appeared on its leaves. In another case, where the salts of the last experiment were supplied, with the addition of a little carbonate of magnesia, no such appearance was observed, and the plant was, besides, in all respects materially improved. It was ascertained further, that soda could not be substituted for potash, nor magnesia for lime, without injury to the plant. Many other experiments with the omission of individual constituents were made, from which it was inferred what are essentials and what are not. The conclusion from the whole investigation was, that silicic, phosphoric, and sulphuric acids, potash, lime, magnesia, iron, and manganese, are essential constituents of the oat plant.—*John A. Porter, Albany Cultivator.*

INTERESTING EXPERIMENTS ON FLOUR AND WHEAT.

Professor Lewis C. Beck has been for some time engaged in making investigations into the chemical constituents of the breadstuffs of the United States, and he has embodied the results obtained, as far as relates to flour and wheat, in a report which is published with that of the Patent-Office. His object was to ascertain how the intrinsic value of the various breadstuffs may be determined, their injury guarded against, and their adulterations detected.

merely to carbonic acid; that all the water of large towns contains organic matter; that water purifies itself from organic matter in various ways, but principally by converting into nitrates; that water can never stand long with advantage, unless on a large scale, and should be used when collected, or as soon as filtered.

DURABILITY OF ICE.

"SIR FRANCIS HEAD, in his 'Emigrant,' has attributed the durability of the Wenham Lake ice, or its power of resisting liquefaction, to the intense cold of a North American winter. It is perfectly true that this ice does not melt so fast as English ice, but the cause of this phenomenon is, I believe, very different from that assigned for it by the late Governor of Upper Canada. There can be no doubt, that where an intense frost gives rise to a great thickness of ice, permitting large cubic masses to be obtained after the superficial and porous ice has been planed off, a great advantage is afforded to the American ice-merchant, and the low temperature acquired by the mass must prevent it from melting so readily when the hot season comes on, since it has first to be warmed up to 32° Fahr., before it can begin to melt. Nevertheless, each fragment of ice, when removed from the store-house, very soon acquires the temperature of 32° Fahr., and yet when a lump of Wenham ice has been brought to England, it does not melt by any means so readily as a similar lump of common English ice. Mr. Faraday tells me that Wenham Lake ice is exceedingly pure, being both free from air-bubbles and from salts. The presence of the first makes it extremely difficult to succeed in making a lens of English ice, which will concentrate the solar rays and readily fire gunpowder, whereas nothing is easier than to perform this singular feat of igniting a combustible body by the aid of a frozen mass, if Wenham ice be employed. The absence of salts conduces greatly to the permanence of the ice, for where water is so frozen that the salts expelled are still contained in air-cavities and cracks, or form thin films between the layers of ice, these entangled salts cause the ice to melt at a lower temperature than 32°, and the liquefied portions give rise to streams and currents within the body of the ice, which rapidly carry heat to the interior. The mass then goes on thawing within as well as without, and at temperatures below 32°; whereas pure and compact Wenham Lake ice can only thaw at 32°, and only on the outside of the mass."—*Lyell's Second Visit to the United States.*

ON THE FREEZING OF ALCOHOL.

IN a recent lecture at Sorbonne, M. Despretz attempted the congelation of alcohol, and to effect this he plunged into liquid protoxide of nitrogen a thin glass tube containing a small quantity of alcohol. The whole was suspended in a small vessel, at the bottom of which was placed a paste, composed of solidified carbonic acid and ether, the concave cover of the vessel being also filled with the same paste.

The whole was then placed under the receiver of an air-pump, and a vacuum was formed. The alcohol soon acquired a marked viscidity, and lost some part of its transparency. At a subsequent lecture, the experiment was repeated with an apparatus composed of two concentric cylinders, the interiors of which were filled with the above-mentioned paste. The double cylinder inclosed on each side the tube containing the protoxide, and that containing the alcohol, and as before the whole was submitted to the action of the air-pump. When the refrigerating substances were considered to have been almost volatilized, the tube containing the alcohol was drawn out, and placed in a horizontal position. The surface of the liquid remained for several moments perpendicular to the axis of the tube, after which the alcohol slowly regained its fluidity. M. Despretz considers that in both cases the upper layer of alcohol was solidified, and that the whole would have been had he continued the experiment a longer time. The want of a further supply of the liquid protoxide prevented him from pursuing the investigations further.—*Comptus Rendus*, *Jan.* 29.

GUN-COTTON.

During the meeting of the French Academy, on Jan. 22, a discussion arose with reference to gun-cotton, which is reported at length in the *Comptus Rendus*, from which we translate the substance of some remarks by M. Morin. He stated that the very quality of great explosiveness, which has been put forward as the chief recommendation of gun-cotton, is in reality a great fault, which has already caused many accidents. During the process of manufacture it cannot be raised to a very high temperature, without great danger of explosion, as has been proved in many cases; and even when only slightly heated, it explodes sometimes without any apparent reason. Gun-cotton cannot safely be raised to more than about one quarter of the temperature which powder will bear. In the using of the gun-cotton, also, much care must be exercised not to get the charge too large, and in reducing its quantity the power is often too much decreased. By experiment it has been found that cannon burst with a charge of gun-cotton of about one fourth the quantity of powder necessary to burst them. Again, a gun can ordinarily be fired with a medium charge of powder from 25,000 to 30,000 times before it bursts, while even with a very small charge of the gun-cotton a gun rarely stands more than 500 discharges. All the means adopted to render the gun-cotton less explosive have been unsuccessful, except where they have been attended with too great loss in the power.

IMPROVEMENT IN SILVERING GLASS.

The object of this invention is to cause the silver to be deposited from a solution of that metal upon glass in such a manner that a precipitate of silver will adhere to it, without any previous coating having been applied. The mode of carrying out the invention is as follows:—One ounce of ammonia, two of nitrate of silver, three of water,

and three of spirit, are carefully mixed together and allowed to stand for three or four hours, after which the mixture is filtered. To each ounce of the liquid is then added an ounce of saccharine matter (grape-sugar being preferred), dissolved in equal portions of spirit and water, say about half a pint of each. This liquid may be used for depositing silver either upon horizontal or vertical surfaces, provided it is kept in contact with the glass, which must be kept heated to about 160° Fahr., until the deposit has been obtained. As soon as the silver on the glass is dry, it may be varnished with common mastic varnish to preserve it from injury. This invention may be employed for depositing silver upon looking-glasses and all other descriptions of glass. The process is not unhealthy, and there is not at any time a disagreeable smell. The coating of silver is very durable, and is capable of withstanding heat as well as damp.—*London Journal of Arts, July*, 1849.

APPLICATION OF GUN-COTTON TO THE SILVERING OF MIRRORS.

MR. H. VOHL, a member of the Paris Academy of Sciences, has discovered that a solution of gun-cotton in a caustic alkaline lye possesses in a high degree the property of precipitating silver from its solutions in the metallic forms. If gun-cotton be placed in contact with a caustic alkaline lye of sufficient strength, the cotton dissolves, disengaging considerable heat and also ammonia, and furnishing a deep brown liquor, which, on the addition of an acid, gives rise to a brisk effervescence, with a disengagement of carbonic and nitrous acids. The manner in which the gun-cotton comports itself shows that it is not dissolved as such, but undergoes a decomposition, in which the atoms of the oxygen in the nitric acid combine with an atom of the carbon of the cotton, and give rise to the carbonic acid, which, as well as the nitrous acid, combines with a portion of the potash. A new decomposition of the nitrous salt by the potash, in presence of substances containing hydrogen, furnishes the ammonia. The following is the most remarkable property of this alkaline solution. If a few drops of nitrate of silver be added to the solution, with enough ammonia to redissolve the oxide of silver which is formed, and if heat be applied gently by means of a water-bath, a moment arrives when the liquid assumes a dark brown color, showing an effervescence, and then all the silver is precipitated on the sides of the wood containing the solution, as a polished mirror. This mirror surpasses in brilliancy that obtained by ethereal oils or ammoniacal aldehyde. It is found also that cane-sugar, milk-sugar, mannite, gums, and other substances which become explosive when treated with nitric acid, act in the same manner. Picroazotic acid, under the same circumstances, produces a bright metallic surface. It would seem that this reaction takes place with all bodies which do not furnish the products of oxidation when treated with nitric acid.

PHOSPHORUS IN IRON.

AT the meeting of the British Scientific Association at Birmingham, *Mr. Rinman* stated that phosphorus had been discovered in

Swedish iron, whenever it presented the peculiarity of what is technically termed "cold short." The process adopted was the following:—The pig-iron, weighing about three grams, and reduced to small pieces, was dissolved in diluted nitric acid, the solution evaporated to dryness, the dry mass heated strongly with free access of air, in order to destroy all carbon. After heating, the dry mass was triturated and mingled with six times its weight of soda, a little chlorate of potassa, and a little silica, and smelted as long as any gas was disengaged. The smelted mass was exhausted by boiling water, and digested for some hours. The solution was filtered, the undissolved residue washed with hot water, containing a small quantity of chloride of ammonium. The solution was evaporated to dryness, and the dry mass treated with hydrochloric acid and dissolved in water. After filtration, the solution was neutralized, and the phosphate of lime was precipitated in a closed vessel by a solution of chloride of calcium with ammonia. Dr. Percy spoke of the importance of this inquiry,—particularly in such a district as Birmingham. He then instanced many of the peculiarities of the Staffordshire iron, which contains phosphorus; and spoke of the peculiarity of the Berlin iron, which is so singularly fluid in casting, as being probably due to some such combination. Dr. Ronalds, Dr. Miller, and Mr. R. Phillips, confirmed the fact of the general presence of phosphorus in cast-iron.—*Athenæum, Sept.* 15.

MERCURY IN HERMETICALLY-SEALED GLASS VESSELS.

The distinguished Prof. Oersted has discovered that a change takes place in mercury kept in hermetically-sealed glass vessels, but that it is very slow and not perceptible for years. He had observed it twenty years ago in a glass bulb. He first took up the subject in 1828, experimenting with four bulbs, two of white and two of green glass, carefully weighed, in order to detect any portion of air that might be admitted through the pores or fissures of the glass. The weight, however, remained unaltered. In July, 1839, a small change was visible. At first a feeble ring of yellow powder adhering to the glass was observed, where the mercury had been a long time in contact with it. And again, in a new place, under similar circumstances, a new ring was formed, and so on. The surface itself, upon which the mercury had rested some time, had a thin covering of yellow adherent powder. In the course of years the yellow powder became black, the mercury had lost a great deal of its fluidity, and it adhered slightly to the glass. The order in which the two colors follow each other indicates that they are not produced by oxidation. In the green bulbs no change was visible. In 1845, Prof. Oersted procured twelve bulbs, six of which should contain, beside the mercury, atmospheric air, the air of the other six being expelled by boiling mercury; three of each series were white, and three green glasses. In July, 1847, there was no sensible change in the series, where air was mixed with the mercury, but in the other, where the air had been exhausted, change had taken place in all but one. Rarefaction of the air had no con-

nection with the phenomena, but the boiling of the mercury seemed to have some influence on them. On analyzing the two powders, sulphur was detected. But as a yellow compound of mercury and sulphur contains oxygen, and as no oxygen was found in the black powder, it may be questioned whether the first compound takes oxygen from the air of the bulb, and returns it in passing to the state of the black one, or whether some hitherto unknown exchange takes place between the elements of the glass and the mercury.

ON THE MANUFACTURE OF SODA.

FROM a lecture read before the Royal College of Chemistry, in London, by Dr. Sheridan Muspratt, on the manufacture of soda, we make the following extracts:—

"The present method of making soda from common salt (chloride of sodium) was discovered by Leblanc, a Frenchman, near the close of the last centnry. It was not, however, successfully introduced into England until the year 1820. Before the manufacture of this alkali, two articles were used in its place, namely, Spanish barilla and kelp. The former contained about 18 per cent. of alkaline principle, and sold for £11 per ton, the latter about five or six per cent., and cost £5 per ton. It is clear that out of 100 parts of these substances 95 parts of kelp and 82 parts of barilla were loss, because they were of no service in the manufacture of soap. The introduction, therefore, of so strong and cheap an alkali as soda would necessarily prove a great boon to the soap-maker; but at the commencement it was very difficult for the soda-manufacturer to dissipate the prejudices in favor of kelp and barilla. As soon, however, as it was shown that soap could be alkalized for £2 per ton instead of £8, and that the operation was performed in one third of the time, the soda immediately came into general demand, so that in less than twenty years from its first introduction the quantity of soda manufactured exceeded 72,000 tons. Of this quantity one manufacturer produced one ninth, and Liverpool exported as much soap as the whole of England had done prior to the introduction of soda.

"But the change produced by the introduction of the manufacture of soda into England, as regards the traffic and importations of several articles, is still more curious, as shown by the following table:—

Importations.	1824.	1847.	Increase.	Decrease.
Pot and pearl ashes,	58,126 barrels.	19,644 barrels.		38,482
Palm-oil, ...	8,997 casks.	56,891 casks.	47,894	
Sulphur, ...	5,447 tons.	24,220 tons.	18,773	
Barilla, ...	5,722 tons.			

"The quantity of soda exported from Liverpool alone to the United States, in the year 1847, was upwards of 8,000 tons.

"On viewing the above statistics, we find that the quantity of alkali shipped from one port is much greater than all the potashes imported into England. The import of sulphur has increased more than four-fold, and palm-oil six-fold, from 1824 to 1847; foreign barilla is entirely superseded. Although in this number of years the imports of

other articles have increased, yet in no other articles, except cotton and sugar, has there been any thing approaching such augmentation. It is also worthy of remark that one ton of soda ash goes as far as eight tons of kelp and three tons of barilla; therefore, taking the charge now made for a ton of barilla and a ton of kelp, compared with that of soda, a saving has been effected equivalent to £1,500,000; and taking the prices of these articles, previous to the introduction of soda, upwards of £5,000,000 has been saved to England. There is another point in which this subject is of the highest importance. The great importation of palm oil from the Western Coast of Africa shows the benefit of this manufacture. Slavery, which can never stand in the presence of commerce, must be thereby considerably checked. The alkali manufacture is thus indirectly the minister of civilization, for by establishing a system of regulated industry among the African nations, it makes local labor valuable."

NEW PROCESS FOR THE MANUFACTURE OF ALKALIES.

Mr. Tilghman, an ingenious American gentleman residing in England, discovered and patented, in 1847, a method of decomposing the alkaline salts by means of steam at high temperatures, and of producing salts of potassa from felspar. The invention consists in decomposing the sulphates and chlorides of the alkalies and alkaline earths, by exposing them at a high temperature to a current of steam, by which the acid is carried off, and the alkaline base either remains free, or enters into combination with some third substance provided for that purpose. The acid vapors passing off are condensed to form sulphuric and hydrochloric acids. To obtain potassa from felspar, the inventor heats together a potash felspar, with carbonate of lime, and the sulphate of lime, baryta, or strontia; the mixture is afterwards lixiviated with water. It is estimated that these discoveries will effect a saving of nearly one half the expense in the manufacture of soda and potash. The apparatus and the methods of Mr. Tilghman have recently been introduced into the immense soda manufactories of Mr. Tennants, at Glasgow, Scotland, and have thus far proved to be superior to any of the former processes. In 1848, sulphuric acid, valued at more than $5,000,000, was manufactured in Great Britain, and when it is considered that Mr. Tilghman is able by his process to manufacture this also at a cheaper rate, the importance of the discovery becomes considerably enhanced.

NEW MODE OF MANUFACTURING SULPHATE OF SODA.

We learn from the *Comptes Rendus* for Feb. 5th, that Messrs. Thomas, Dellisse, and Boucard have presented to the Academy the description of a new process for converting culinary salt into sulphate of soda by means of the sulphate of iron. This would allow the pyrites to be turned to very good account. The dry and pure sulphate of soda would not cost more than 2½ francs the 100 kilograms,* instead of 12 to 18 francs, which is the ordinary price. The new process

* A kilogram equals 2lb. 3 oz. Avoirdupois.

would, moreover, avoid all the disadvantages attending the production of the vapors of muriatic acid.

FLEXIBLE IVORY.

M. Charrière, a manufacturer of surgical instruments in Paris, has for some time been in the habit of rendering flexible the ivory which he uses in making tubes, probes, and other instruments. He avails himself of a fact which has long been known, that when bones are subjected to the action of hydrochloric acid, the phosphate of lime, which forms one of their component parts, is extracted, and thus bones retain their original form, and acquire great flexibility. M. Charrière, after giving to the pieces of ivory the required form and polish, steeps them in acid alone, or in acid partially diluted with water, and they thus become supple, flexible, elastic, and of a slightly yellowish color. In the course of drying, the ivory becomes hard and inflexible again, but its flexibility can be at once restored by wetting it, either by surrounding it with a piece of wet linen, or by placing sponge in the cavities of the pieces. Some pieces of ivory have been kept in a flexible state, in the acidulated water, for a week, and they were neither changed, nor injured, nor too much softened, nor had they acquired any taste or disagreeable smell.—*London Patent Journal.*

ANNIHILATION OF THE SMELL OF MUSK BY ERGOT OF RYE.

Some years ago, the emulsion of bitter almonds was found to possess the property of annihilating the smell of musk, and most of the cyanic preparations evinced the same power. According to M. Mertot, a druggist of Bayeux, in Normandy, ergot of rye will produce the same effect. "I had," said he, "to prepare a number of pills, containing both musk and ergot,—hardly were the two substances mixed, than the smell completely went off, so much so, that the patient, who was not aware of the nature of the pills, only noticed the musk by the effects of flatulency."—*Journal de Chimie Médicale.*

MODE OF COLORING STONES ARTIFICIALLY.

The ancients valued gems and parti-colored stones so highly, that it finally became very common to produce by artificial means copies of genuine stones, or to enhance the beauty of the latter. Among the various processes employed by the ancients for the coloring of these gems is one described by Pliny, which up to the present time has been generally, although erroneously, treated as a fable; this process consisted in boiling the stones with honey, during at least seven or eight days, and it is a curious fact, that this identical process is still employed in the agate manufactories of Oberstein and Idar, for the purpose of converting chalcedonies and red and yellow cornelian into fine onyx. This process was for many years known only to an agate merchant of Idar, who had probably purchased it from some Italian artist. The coloring of these stones is founded on the following prop-

erty. The ribbons or zones in the different varieties of chalcedony, which, in the kidney-formed masses of that substance, lie superimposed, differ in their texture and compactness; but owing to their similarity of color in the natural state, they can only be distinguished from each other with difficulty. The stone is, however, capable of absorbing fluids in the direction of the strata; this property the strata possess in different degrees; therefore, if a colored fluid be absorbed, and the quantity taken up by the pores of the stone is different for every stratum or zone, it is clear that a number of tints will be produced corresponding to the number of zones, each of which will be rendered distinct and colored in proportion to the quantity of fluid it may have absorbed. Thus, a specimen of stone naturally but slightly colored may, by this treatment, be rendered equal to fine stratified chalcedony or onyx, and may be employed equally well in the engraving of cameos, or for any other purpose where the variety of color can be rendered available. The signs of value in these stones, when in their rough state, are recognized by the merchants by an empirical test, which rests upon the property of the absorption of liquids. In the trial, a small piece is broken off that part of the rough stone which is expected to be of marketable value. When polished, this fragment is moistened by the tongue; the buyer then remarks carefully the rate at which the moisture dries away, and also whether the absorption takes place in alternate bands or zones, and in one zone more rapidly than in another. By this they judge of the beauty and value of the stone. —*London Journal of Arts*, *Dec.*

ARTIFICIAL FORMATION OF MINERALS IN THE DRY WAY.

M. DE SENARMONT has been successful in forming several minerals by the humid way, which appear to throw much light on the processes employed by nature in the formation of mineral veins, and many of the earthy minerals found in the granitic rocks. He incloses in a strong glass tube hermetically sealed the substances to act upon each other,—as, for instance, sulphate of iron and carbonate of soda, in solution. The tube, being cautiously sealed, is placed in a gun-barrel, half full of water, and this being also closed, the whole arrangement is exposed to the action of heat. Double decomposition of course follows the mixing of the above salts; but under the increased pressure and temperature, the carbonate of iron is redissolved, and eventually deposited in crystals of a grayish white character, which are not altered by exposure to the air. The following is an account of some of his results.

He formed *carbonate of magnesia* from sulphate of magnesia and carbonate of soda, temperature about 160° C. It was in the state of white crystalline grains, hardly attacked by the acids.

Carbonate of iron from sulphate of protoxide of iron and carbonate of soda; temperature 150° C., and above. Also, from protochloride of iron and carbonate of lime; temperature between 130° and 200° for twelve, twenty-four, and thirty-six hours.

Carbonate of manganese from chloride of manganese and carbonate

of soda; temperature about 160° C. Also, from chloride of manganese and carbonate of lime; temperature between 140° and 170° C., for twelve to forty-eight hours.

Carbonate of zinc from a process like that for carbonate of iron.—*Comptes Rendus, June*, 1849.

METHOD OF OBTAINING CRYSTALLINE COMBINATIONS BY HEAT, AND OF REPRODUCING THEREBY VARIOUS MINERAL SPECIES.

IT is known that borax, boracic acid, phosphoric acid, and the alkaline phosphates, dissolve metallic oxides with ease, at a certain temperature, and abandon them at a much higher temperature by virtue of their volatility. These bodies enjoy, therefore, in regard to the oxides which they hold in solution, the function which water possesses at the ordinary temperature, or at temperatures more elevated in relation to bodies held in solution by it,—that very often on evaporating it leaves such bodies in a crystalline condition. This simple principle has led M. Ebelmen to a method which will enrich chemistry, by the dry method, with a great number of novel combinations, and which will establish the most intimate connection between mineralogy and chemistry. On mingling together, for example, alumina and magnesia in a little larger proportion than they exist in spinel, with a portion of fused boracic acid, and exposing the mixture to the most elevated temperature of a porcelain furnace, octahedrons are obtained which possess the composition and properties of spinel. These crystals are rose-red or blue according as the oxide of chrome or of cobalt is used. M. Ebelmen has obtained in this way chrysoberyl, and many other aluminates. He has prepared many varieties of chrome iron, which all present regular octahedrons with the usual mineralogical characters, and has also obtained, by the aid of this process, the emerald and peridot crystallized. Boracic acid is too volatile to aid in crystallizing alumina, and in this case he employed borax. By the addition of a little oxide of chrome, crystals of red ruby are obtained, having the formula of transparent corundum.—*Comptes Rendus.*

ASPARAGINE.

M. DUMAS has communicated to the Paris Academy of Sciences an important paper by M. Dessaignes on asparagine, which he finds existing in the young shoots of the plants that compose the family Leguminaceæ. He appears to suppose it to be the legumine which is in the act of germination changed into asparagine.—*London Athenæum, Feb.* 3.

NEW METHOD OF COPYING ENGRAVINGS.

AT a meeting of the Royal Society in May, M. Niepce exhibited a drawing produced by the following ingenious process. An engraving is placed in a box containing iodine, at such a temperature that a small portion is vaporized. The ink of the engraving condenses a much

greater proportion of the vapor than the mere blank paper; so that when, after a few minutes, the engraving is taken out, exposed for a moment or two to the air, and then laid on a film of starch, part of the iodine becomes detached from the engraving, and is transferred to the film of starch, producing a very delicate and beautiful copy of the engraving. It is necessary to inclose the film of starch between two glass plates in order to preserve it.

IMPORTANT DISCOVERY IN THE PREPARATION OF PAINT.

M. LECLAIRE, a somewhat celebrated house-painter of Paris, after a series of difficult and unceasing experiments, has made a very important discovery in the art of mixing paints. It is an undisputed fact, that white lead, which is by far the most important ingredient used in mixing colors, contains an active and very deadly poison, and persons who work with it are often subjected to what is termed the "painters' cholic." The prevalence of this disease is shown by the fact, that, in 1841, 302 persons affected with it were admitted into the hospitals of Paris, of whom 280 were cured, 12 died, and 1 became insane.

M. Leclaire's attention having been directed to this subject, after years of labor he has succeeded in discovering a preventative for this disease. To show the problem he had to resolve, we enter somewhat into detail.

The fundamental colors in painting, those by means of which all possible tints are obtained, are white, black, yellow, red, and blue, and for greater facility green is added; gray is a mixture of black and white, green of yellow and blue, violet and indigo of red and blue, &c.

The most important of the primitive colors, that which it is the most essential to render perfectly innocuous and unchangeable, is white, which enters into the composition of nearly all paints. The white exclusively employed now is the white oxide or carbonate of lead, of which that called the white of silver is only a more perfect variety. But the oxide of lead is at once a violent poison and eminently subject to decomposition; it becomes dirty and black, and is destroyed by contact with sulphurous vapors, which are so abundant in nature that it is impossible with every imaginable care to protect it from their corroding influence. For the yellow, we have the chromes and the orpines, which, though durable, are very deleterious. The blues and the blacks are at once harmless and durable. The greens are either very expensive, or deleterious, or subject to rapid decomposition.

All these defects M. Leclaire has supplied. He produces a pure, dazzling, and durable white, by means of the oxide of zinc; various tints of yellow from the same; an excellent red, having for its base sulphide of antimony; and a number of fine greens by means of oxide of zinc and sulphate of copper. He also prepares an oil to be used with these paints, which is obtained by boiling 100lbs. of linseed oil with 5lbs. of peroxide of manganese.

Of the complete success of M. Leclaire's paints there is abundant

evidence. He has painted over six thousand public and private establishments,—the Departments of War and of Public Works, the Bank of France, the Prefecture of Police, the railroad depots, &c.,—and in every instance the fact is conclusively established, that the colors, with their bases of zinc, manganese, &c., are by no means injurious to the health of the workmen engaged in their manufacture, to painters using them, or to the persons who may reside in houses freshly painted. Of the correctness of this statement it is only necessary to say that, under the old order of things, a dozen of M. Leclaire's workmen, on an average, were attacked yearly by this unpleasant disease; whereas, now, not a single person in his employ has been poisoned. The new colors are infinitely more solid and durable than the old; they preserve everywhere and always their primitive tints, even in sulphuric bath-rooms; and they have a property still more precious, namely, when they are cleansed by simple washing, they resume their original brightness, while the old colors, when washed even with acids, which dissolve a portion, remain dull and spotted, and for the simple reason, that every thing which decomposes stains them. The white of zinc is so much superior to the white of lead, that when the framing of a panel is painted with the best white lead and the centre with zinc-white, the contrast makes the framing look yellow and gray and offensive to the eye. In such a comparison, even the Venetian white loses its purity. The white lead appears to absorb the light, while the white of zinc reflects it completely, and is brilliant and transparent. The new colors are much richer and brighter, are easily applied, and dry in a very short time. They are also more economical, for experience has fully proved, that, if we compare the quality of white of lead with the white of zinc, or the quantities of oil necessary to prepare these two substances, the advantage of at least thirty per cent. is in favor of the white of zinc, which covers better with equal weight.

M. Leclaire has received the Cross of the Legion of Honor, as a reward for his discovery.

DEODORIZING POWERS OF PEAT CHARCOAL.

At a meeting of the Mechanics' Institute, in London, several experiments were tried, having for their object the exhibition of the deodorizing powers of a species of charcoal prepared from Irish peat. In one of the experiments a pan of night-soil was put in a hopper along with two pans of peat charcoal. The mixture was then ground in an ordinary hand-mill, and delivered into a vessel, where it was examined by many scientific men, who all agreed in considering the experiment successful, as they could not detect the least disagreeable odor. One of the inspectors of the Board of Health stated that this charcoal would afford an admirable means of disinfecting cesspools. A gentleman also stated, that he had tried its effect with complete success on various kinds of manure. Mr. Rogers, the inventor, remarked that he had given unremitting attention to the subject for five years, and that he could deliver, in London, the coal made from Irish peat at about twelve dollars the ton.

INTERESTING EXPERIMENT WITH STRYCHNIA.

An interesting experiment, illustrative of the poisonous effects of strychnia, was recently made by Professor Agassiz, at Cambridge. The subject was a large black bear, about eighteen months old. The animal was taken when young, and had been kept in captivity for a considerable period. Professor Agassiz being desirous of killing it for the purpose of dissection, about three grains of strychnia were administered in a biscuit. The poison, although extremely bitter, was readily swallowed. At the expiration of ten minutes, no effect having been produced, a second dose of about the same quantity was also inclosed in a biscuit and offered. The cunning animal broke open and swallowed the biscuit, but rejected the poison. The first portion, however, had proved efficacious, and in exactly fifteen minutes from the time when first administered, the animal was seized with terrible convulsions, and soon died. The whole time which elapsed between the taking of the poison and the death of the animal did not exceed twenty-five minutes. In order to alleviate its sufferings and hasten death, a quantity of hydrocyanic acid was poured upon the nose and mouth of the bear. It did not, however, produce any sensible effect, and was not *apparently* taken into the system, as the animal at the time was nearly dead. But the subsequent effects of the poison were most remarkable. Although the bear, at the time of death, was in perfect health and strength, twenty-four hours had not elapsed before the body was in an advanced stage of decomposition. Indeed the appearances indicated that the animal had been dead nearly two months. The interior of the body, when opened about twenty hours after death, still retained its warmth in a considerable degree, while an offensive gas issued from every pore. The blood had not coagulated, the spinal marrow and nerves were in a semi-fluid state, and the flesh had assumed a leaden-gray color. The hair of the hide readily came out, on being slightly pulled. No smell of the hydrocyanic acid could be perceived.

The origin of this singular and speedy decomposition is not fully known, though it is supposed to be due to the agency of the hydrocyanic acid. A chemical examination of the muscle, brain, nerves, liver, and kidneys is now going on at the Cambridge laboratory, under the direction of Prof. Horsford. One singular fact connected with the spontaneous decomposition of these parts is, that they all yielded or disengaged hydrosulphuric acid gas, with the exception of the liver, which did not.—*Editors.*

ON THE COMPOSITION OF STEARIC AND MARGARIC ACIDS.

The composition usually assigned to these acids makes them two different oxides of the radical, analogous to the arrangement in hyposulphuric acid and sulphuric acids. The acids are supposed to be anhydrous. Recent experiments have shown that the atomic weight of the two acids is the same. Seven analyses of stearic acid, derived *from different* sources, gave results strikingly concordant, and afford-

ed the formula, exactly, for margaric acid. This discovery, which places stearic and margaric acids in the same relation with tartaric and racemic (metatartaric) acids, generally simplifies the whole of a hitherto intricate subject, and, above all, does away with the difference between the fat of man and the pig and that of other animals, a result highly important in physiology.—*Comptes Rendus, March.*

CURIOUS EFFECTS OF GLONOINE.

THIS body was discovered about two years since by M. Sobrero, and is formed by the action of nitro-sulphuric acid upon glycerine. It is a heavy yellow oil, insoluble in water, inodorous, but sweet, pungent, and aromatic to the taste. The physiological action of this substance is most extraordinary; the following have been the results of a series of experiments upon man and the lower animals, performed by Dr. Hering, with some other medical gentlemen of Philadelphia. When taken in small doses the effect is an almost immediate acceleration of the pulse, with giddiness and the sense of fulness and pressure in the frontal region, followed by severe headache, which is often confined to the coronal region, sometimes to one side of the head, and attended with twitchings of the muscles of the face, and sometimes a difficulty in articulation. The pain is greatly aggravated by motion, and, on shaking the head, is almost intolerable. These symptoms subside spontaneously in a short time, and are often succeeded by a diminished pulse and a feeling of soreness about the head. The most extraordinary feature connected with these observations is the very minute quantity required to produce the effect described. In the experiment of Dr. Hering, one drop of the glonoine was placed in a bottle, to which 5000 globules of milk-sugar were added, and, by agitating, the whole was impregnated. The number of these globules required to produce the symptoms above described is from 5 to 20, 50, and in some individuals 200. The majority of persons experience the symptoms in a marked degree, after having taken $20 = \frac{1}{250}$th of a grain, and many susceptible subjects are painfully affected by $5 = \frac{1}{1000}$th of a grain. The lower animals are less sensible to its action; ten drops were required to destroy a frog; four drops given to a cat produced convulsions, but the animal recovered; another cat was killed by three drops. The strongest dose taken by a man has been one tenth of a drop. Common coffee is found to be an antidote to the unpleasant effects of an overdose. A substance of such unexampled potency in its action upon the human system, can scarcely be without its use in the treatment of disease; we understand that a careful examination is now making of it, with a view to its practical application and use.—*Condensed from Silliman's Journal.*

OZONE.

SOME observations and experiments on ozone have been published by Williamson, an early investigator on this interesting subject. He critically examines the view adopted by Schönbein, the discoverer,

and is inclined to consider ozone as a peroxide of hydrogen. He explains its formation by the action of phosphorus upon steam and oxygen by the transference of chemical action. The combination of phosphorus with oxygen occasions a simultaneous formation of peroxide of hydrogen by the union of water and oxygen. Schönbein states, as the result of some recent experiments, that ozone, produced either by means of phosphorus, by galvanic decomposition of water, or by frictional electricity, decomposes solutions of the salts of protoxide of manganese, with separation of hydrated binoxide. Paper moistened with such a solution becomes brown. Under the influence of solar radiation, chlorine and bromine water act in the same manner, though more slowly. Chlorine and bromine water, or atmospheric air impregnated with ozone, produce from basic acetate of lead brown binoxide of lead. Solutions of the salts of protoxide of manganese may thus be employed as sympathetic inks; writing of this kind, when exposed to the vapor of ozone, immediately becomes brown; the color disappearing, after some time will reappear when exposed again to the ozone. Schönbein has also published the result of some investigations on the presence of ozone in the atmosphere. A mixture of starch-paste and iodide of potassium became gradually blue in the open air; paper moistened with sulphate of protoxide of manganese slightly changed to brown, in the same manner as in air impregnated with ozone; this does not, however, take place in confined air. He considers it very probable that the proportion of ozone in the atmosphere stands in intimate relation to the prevalence of catarrhal affections.

While no ozone is produced by phosphorus in moist oxygen, at the ordinary temperature and density of the air, it is formed according to Schönbein in oxygen rarefied, or heated above 24°; generally under those conditions under which phosphorus becomes luminous in oxygen.

In connection with his researches on ozone, Schönbein has published a memoir on the various chemical conditions of oxygen. He endeavours to establish the view, that oxygen may exist in two different states, in the ordinary form, and in the state in which it is more inclined to enter into chemical combination; the latter form he distinguishes by the terms oxylized oxygen. He mentions those compounds in which he supposes the presence of oxylized oxygen, and expresses some doubts regarding the supposition, that ozone is oxygen in a peculiarly modified state.

Some experiments have been described by Osann, according to which no ozone was produced by the electrolysis of pure water; whilst the diffusion of frictional electricity into an atmosphere of hydrogen gave rise to the odor of ozone. He found that ozone-odor was invariably produced, whether the frictional electricity was discharged either from platinum, copper, brass, or iron. He considers that these experiments are equally unfavorable to the view, that ozone is an oxide of either hydrogen or nitrogen, and asks whether the electrical ozone-odor in reality belongs to the same substance which is obtained in chemical processes. In a more recent communication he acknowledges the identity of phosphorus ozone and that which is generated

by electricity. For the preparation of ozonized oxygen, he recommends the electrolysis of a concentrated solution of sulphate of zinc containing undissolved crystals.—*Liebig's Annual Report.*

From the above it will be seen that chemists are not yet fully agreed concerning the nature or production of this singular substance, ozone. To Schönbein and Williamson we are indebted for most of our knowledge concerning it. The latter has supposed it to be a compound of oxygen and hydrogen, from the fact, that, when the ozone completely freed from moisture was passed over ignited copper, water was produced. De la Rive produced it by passing a current of electricity through pure dry oxygen gas, contained in a receiver. It is also obtained in large quantities by passing oxygen gas over moistened phosphorus and afterwards drying it. Thus prepared, it is a powerful chemical agent, possesses bleaching properties, oxidizes the metals with rapidity, and destroys India-rubber. The hydrogen acids of sulphur are decomposed by it, water being formed by uniting with the hydrogen of the acid, and sulphur being set free. Prof. Horsford has observed that ozone subjected to a heat of 130° Fahrenheit entirely loses its properties. Ozone, like chlorine, precipitates iodine, coloring a solution of iodide of potassium and starch a deep blue color. The peculiar smell prevalent in the vicinity of objects struck by lightning, as well as that occasioned by the excitation of an electrical machine, and by the striking of two pieces of silica together, is believed to be occasioned by ozone.—*Editors.*

METHOD OF DETERMINING THE AMOUNT OF OZONE IN THE ATMOSPHERE.

At the meeting of the American Association, an instrument for determining the relative quantity of ozone in the air was presented by Prof. Horsford. It consisted of a tube, containing at one end a plug of asbestos, moistened with a solution of iodide of potassium and starch. This plug within the tube, attached to an aspirator, would, as air passed over it, become blue. If much water flowed from the aspirator, and of course much air flowed over the asbestos before it became blue, the quantity of ozone indicated would be small. If but little water flowed (and this could be measured), the quantity of ozone indicated would be greater. The quantities of ozone would be inversely as the volumes of air passing through the tube before blueness is produced.

THE MOISTURE AND AMMONIA OF THE ATMOSPHERE.

At the last meeting of the American Association, Prof. E. N. Horsford, of the Lawrence Scientific School, communicated the results of some observations undertaken with the object of ascertaining the amount of moisture, ammonia, and organic matter existing in the atmosphere. The observations of the moisture recorded by Prof. Horsford commenced on the last day of February, and were continued until the 12th of April, and

thence occasionally down to the 20th of July. They were accompanied by notes of the barometer, the temperature, and the direction and force of the wind. Among the results obtained were the following, as briefly given by Prof. H.

That, other things being equal, the moisture is in general proportioned to the temperature; that slight variations of temperature are not accompanied by corresponding variations in the quantity of moisture, and that great variations in the quantity of moisture may take place, while the temperature and altitude of the mercurial column remain constant. The quantity of the moisture, too, has even doubled in the course of an hour, although the temperature became reduced. In general, again, the moisture on the same day seems to depend chiefly o the direction of the wind.

The least quantity of moisture was observed during a northwest or north-northwest wind; the largest, during a southwest or south-southwest wind. The former occurred on the 12th of March, and the latter on the 23d of June last. The quantity on the latter day was to that on the former as more than fifty to one.

The method employed was that of Brunner, which consists of an apparatus for transmitting a known volume of atmospheric air through a chloride-of-calcium tube, previously and subsequently weighed. The difference between the weights before and after the experiment presents the amount of moisture in a given volume of air.

The permeability of atmospheric air to aqueous vapor was established by experiment, and the observations extended through a period of several months. It has been observed, that the *striking through of ink employed in writing* takes place more promptly in very hot than in cooler weather. A piece of writing paper of known superficial area was placed in a glass tube closed at one end, and weighed from day to day, noting at the same time the temperature. It was found to weigh more as the temperature was higher.

The quantity of ammonia in the air was determined by an apparatus of the author's construction. The object in view in the arrangement of the apparatus was, to provide that the air should, by means of an aspirator, be transmitted through a constantly renewed atmosphere of hydrochloric acid vapor. To this end, a series of tubes and flasks containing asbestos drenched with hydrochloric acid were connected with a safety-tube, which was connected with an aspirator. Through this apparatus a known volume of air was transmitted. At the conclusion of the experiment, the apparatus was thoroughly rinsed with distilled water, and the ammonia determined in the usual manner with bichloride of platinum. Several determinations having been made, it was ascertained that the quantities of ammonia in the *east wind* varied considerably from each other; and such was the discrepancy of the Professor's results that he forbore a statement of quantities ascertained,—except so far as to remark, that they very greatly exceed those obtained by Fresenius in his recent determinations. One determination was made in a locality in Boston pointed out by one of the police-officers as the worst habitable part of the city, and the atmosphere, which was in the highest degree offensive, was not found to

be distinguished on account of its ammonia above that of the ocean in an east wind.

Continued observations on the state of the atmosphere, made since the reading of this paper before the American Association, show that the quantity of ammonia in the atmosphere is subject to constant variation. In the summer, when vegetable and animal decay is most rapid, the quantity is at a maximum, and afterwards decreases regularly until the winter season, when it is at a minimum. The following table shows the amount of ammonia found in the atmosphere at thirteen different analyses.

	Date.	Ammonia in 1,000,000 parts, by weight of air.
1.	July 3	42.9995
2.	July 9	46.1246
3.	July 9	47.6308
4.	September 1 to 20	29.7457
5.	October 11	28.2396
6.	October 14	25.7919
7.	October 30	13.9315
8.	November 6	8.0953
9.	November 10, 12, and 13	8.0953
10.	November 14, 15, and 16	4.7066
11.	November 17 to December 5	6.1328
12.	December 20 and 21	6.9885
13.	December 29	1.2171

SINGULAR COMBINATION OF NITROGEN.

WOHLER, of Germany, has ascertained that the crystals found in the slag of some furnaces, and supposed to be pure titanium, contain both carbon and nitrogen in proportions corresponding with the formula $Ti\,Cy + 3\,Ti^3\,N$. This fact gives us entirely new ideas of the nature of nitrogen, a body supposed to be distinguished above all others for its tendency to take on the gaseous form when its compounds are subject to heat.—*Letter of Prof. Liebig to Prof. Horsford.*

GEOLOGY.

GEOLOGICAL SURVEYS OF THE UNITED STATES.

At the recent meeting of the American Association, resolutions were offered, strongly urging the completion of geological surveys of the several States of the Union which still remain unfinished. There are several cases of this kind, and the interests of the State, the country, and of knowledge, strongly demand that the work be carried forward. Large portions of our territory, rich, it may be, in wealth of minerals, building material, fertile soil, and various productions valuable in the arts, remain unexplored, and, where explorations have been made, there have been delays in the publication of reports, which are not creditable to the legislatures that have this matter in control, nor just to those who have been laboring in the surveys.—*Silliman's Journal.*

GEOLOGY OF THE GOLD REGIONS OF CALIFORNIA.

The following account of the geology of the gold regions of California is compiled from various sources. The region of the Sacramento is remarkable for the great extent of its alluvial plains or flats. Two hundred miles from its mouth they are twenty miles wide, but near Sutter's Fort the width is between fifty and sixty miles. The country about Sutter's Fort during the winter is mostly covered with water, and the same is true of the bottom-lands of the rivers of the gold region. All the gold thus far discovered occurs uniformly in one geological formation. This is the stratum of *drift*, or *diluvium*, composed of a heterogeneous mixture of clay, sand, gravel, and pebbles, and varying in thickness from a few inches to several feet. There are many boulders lying directly beneath the soil, and resting on the rocks below, which, in most of the diggings, consist of gneiss or clay-slate, running about north-northwest and south-southwest, and dipping nearly perpendicularly. The stratum of diluvium is, however, neither horizontal nor of uniform slope, but conformed to the varying inclination of the

earth's surface, covering the declivities, and even the summits of the hills, as well as the bottoms of the ravines and valleys. The sandbars of many of the mountain torrents are extremely rich in metal. Quartz is believed to be the only substance with which the gold is intimately connected. The gold of different localities varies very much in size. That from the banks and sandbars of the rivers is generally in the form of small, flattened scales, and commonly it is found to be finer the lower you descend the stream. That taken from the bottom of dry ravines is mostly of a larger size, and occurs both in small particles and also in small lumps and irregular water-worn masses, from the size of wheat-kernels to pieces of several ounces, or even pounds, in weight. The black, ferruginous sand, which everywhere accompanies the gold, varies in fineness with the size of the accompanying gold.

The slate beds mentioned above often include dikes or beds of quartz rock, in which some have asserted that gold has been found *in place*, but this still wants confirmation. In some of the richest explorations yet made, however, the slate directly underlies the stratum of diluvium mentioned as containing the gold, and this slate has many crevices or "pockets," into which the gold has been washed in considerable quantities, and this fact also has given rise to the belief that gold has been found *in place*.

There can be little doubt that the gold was deposited in its present position by the same agency and at the same time as the stratum in which it occurs. It is a peculiar fact, that some specimens have been found which appear to have been moulded on regular quartz crystals.

To the east of the gold regions are the mountains of Sierra Nevada, consisting of primitive and metamorphic rocks. In the vicinity of these mountains, the gold and its associated quartz disappear; the rocks underlying the drift appear to consist entirely of gneiss, which is afterwards succeeded by granite.

North of the Bay of San Francisco, talcose slates of various colors have been noticed, and also hills of red and yellow jasper, in layers varying from half an inch to four inches in thickness. At the Straits of Caquines, bluffs of red sandstone, alternating with clayey layers, occur. This sandstone, which is believed to belong to the eocene period, is soft and easily worked. On a small island near these Straits, gypsum has been found in considerable quantities.

In a letter, dated at San Francisco, October 29th, and published in *Silliman's Journal* for January, 1850, received since the above was written, Rev. C. S. Lyman states that "gold has at last been discovered *in place*,—in veins penetrating quartz beds,—on the Mokelemnes and in the vicinity of the Mariposa and one or two other places. I have this from gentlemen who have seen the veins, and who are reliable witnesses. These veins are of course not worked yet, as it is more profitable to dig the wash-gold."

The *Pacific News* for November 30th, states that "quartz containing gold has been found in inexhaustible quarries through the whole mountainous region which forms the western slope of the Sierra Ne-

vada. Hon. T. Butler King has spent much time in examining this region, and is about making a report upon it to the government at Washington; it will be accompanied by numerous specimens. We have ourselves examined specimens from these quartz mountain-quarries, which are in the possession of Mr. Wright, one of the members of Congress elect from California, who will take them on to Washington. They consist, for the most part, of small pieces of quartz rock, generally of a brownish tinge, and, in some instances, presenting the appearance of a slight incipient decay, or decomposition of the rock formation. In all these specimens the gold points, or particles, are very slightly, if at all visible to the naked eye. The microscope, however, reveals the gold more clearly. Besides these pieces, which Mr. Wright has himself selected with great care, as the fairest average samples of the general appearance of enormous and very numerous veins, or quarries, of quartz, there is also one larger fragment of the same rock, weighing, we should suppose, some ten or twelve pounds, from all parts of which the gold protrudes plainly in a state almost pure. This single fraction of quartz, which Mr. Wright by no means regards as an average sample of the quarries, but which he pronounces to be the richest rock-specimen he has seen, is found by the most careful specific-gravity test, as applied to it by Mr. Wright, to contain pure gold to the amount of about *six hundred dollars.*

"Mr. Wright has spent much time among the mountains collecting his specimens, and has been assisted by a gentleman conversant with mining operations. The astonishing result brought out by these investigations, is, that, in a particular and very extensive vein, four pounds of this rock yielded, upon the average, $11 worth of pure gold, valued at $16 to the ounce; that is to say, the yield of gold from these average samples of the rock in this particular vein is nearly $3 for each pound of quartz. Mr. Wright exhibited to us two small masses of gold, each about the size and shape of a large musket-ball, and both presenting the granulated appearance of gold extracted and collected by the aid of quicksilver. One of these contains about $12 of pure gold, and is the largest yield which has been obtained from 4lbs. of the rock in question. The other contains about $10, and is the smallest yield which has been obtained from any of the experiments upon the rock of this vein. We understand that the tests applied have been sometimes the operation of quicksilver, and sometimes the test of the comparative specific gravity of the pure quartz and the gold-bearing quartz."

The Secretary of the Interior remarks, in his Annual Report:—

"The gold is found sometimes in masses, the largest of which brought to the mint weighed 89oz. They are generally equal to the standard of our coin in purity, and their appearance that of a metal forced into the fissures and cavities of the rocks in a state of fusion. Some masses, however, are flattened apparently by pressure, and scratched as if by attrition in a rough surface. One small mass which was exhibited had about five parts in weight of gold to one of quartz intimately blended, and both together bouldered so as to form a handsome rounded pebble, with a surface of about equal quartz and gold.

A very large proportion of the gold, however, is obtained in small scales, by washing the earth which is dug up on the beds of the streams or near their margin. A mass of the crude earth, as taken at random from a placer, was tested by the Director of the United States Mint at Philadelphia, and found to contain 264½ grs. of gold, being in value a fraction over $10 to 100lbs. It cannot, however, be reasonably supposed that the average alluvial earth in the placers is so highly auriferous.

COMPARATIVE STRUCTURAL FEATURES OF THE APPALACHIAN MOUNTAINS AND THE ALPS.

At the meeting of the American Association, Professor H. D. Rogers presented an important communication on the "Structural Features of the Appalachian Mountains, compared with those of the Alps and other disturbed Districts of Europe." The characteristic features of the Appalachians are, that on their southeast slopes the strata are invariably doubled into oblique flexures or folds. Farther towards the northwest, or central belts of the chain, these flexures are less perceptible, but the inverted or northwestern side of the anticlinal curves dip much more steeply than the southeastern. Advancing still farther across the chain, these great flexures or arches of the rocks progressively expand, the curvature of the northwestern slopes still, however, dipping very steeply, while in the broad plateaus of the Alleghany and Cumberland Mountains the arches or waves subside and dilate into symmetrical undulations of equal and gentle curvature. Along all the southeastern border of the chain, the prevailing dip is therefore toward the belt of active igneous movement, where alone the strata are perforated by intrusive volcanic rocks. These arches or waves are of great length, and, whether straight or curved, exhibit a singular degree of parallelism and uniformity in their style of flexure. In the southeastern and middle zones of the chain, many of these great arches terminate in enormous longitudinal faults or fractures, which are nothing else than inverted flexures broken at some point in the inverted part of the anticlinal, producing the apparent anomaly of an overlapping of newer strata by others of far older date. Some of these fractures thus ingulf a thickness of nearly two miles. The cleavage planes of the rocks are nearly parallel with the average dip of the planes which symmetrically cut or bisect the anticlinal and synclinal curves; and this law of position of the cleavage planes is found to prevail equally in the plicated districts of the Rhine and the Alps. Precisely analogous features to those which have been observed in the Appalachians have been proved to belong to the paleozoic region of the Ardennes, and the coal-fields of Belgium. In the more disturbed tracts the strata are closely and sharply folded into almost absolute parallelism, while farther north, in the carboniferous basins of the Meuse, these flexures dilate precisely as in the sections of the Alleghanies. The cleavage planes of the more contorted belt are, as in the Appalachian region, planes which divide the curves, parallel to the average dip of the axes. In the Jura, the same beautiful law of a

peculiar curvature prevails, the great anticlinal exposing invariably, or, with rare exceptions, a much steeper dip upon the side which faces the Alps, than upon the opposite side. The average dip of the northwestern abutments does not amount to 40°, while that of the southeastern even exceeds 70°. In regard to the chain of the Alps, Prof. Rogers proved that it consists of two principal zones of closely-plicated strata. The entire belt of the Bernese Oberland displays folds which dip inwardly toward the high central peaks, with a parallel or south-dipping system of cleavage. The southern chain of the Monte Rosa exhibits a similar system of flexures, but of an opposite order of dips, these being directed toward the north, and, therefore, also inclining inwards, toward the high central summits. This opposite direction of the folds in the two opposite flanks of the chain at once explains the hitherto unsolved phenomenon of the inward dipping or fan-like position of the planes of stratification. The cleavage dips on each flank of the chain, as in every other district, are parallel with the average dips of the anticlinal folds.

LYELL'S VIEW OF THE GEOLOGY OF THE MISSISSIPPI VALLEY.

THE delta of the Mississippi may be defined as that part of the great alluvial slope which lies below, or to the south of the branching off of the highest arm, or that called the Atchafalaya. Above this point, which is the head of the delta, the Mississippi receives waters from its various tributaries; below, it gives out again, through numerous arms or channels, the waters which it conveys to the sea. The delta, so defined, is about 14,000 square miles in area, and elevated from a few inches to ten feet above the level of the sea. The greater part of it protrudes into the Gulf of Mexico, beyond the general coast-line. The level plane to the north, as far as Cape Girardeau in Missouri, above the junction of the Ohio, is of the same character, including an area of about 16,000 square miles, and is, therefore, larger than the delta. It is very variable in width from east to west, being near its northern extremity 50 miles wide, at Memphis, 30, at the mouth of the White River, 80, and contracting again farther south, as at Grand Gulf, to 33 miles. The delta and alluvial plain rise by so gradual a slope from the sea, as to attain at the junction of the Ohio (a distance of 800 miles by the river), an elevation of only 200 feet above the Gulf of Mexico.

Finding it impossible to calculate the age of the delta from the observed rate of the advance of the land on the Gulf in each century, I endeavoured to approximate, by a different method, to a minimum of the time required for bringing down from the upper country that large quantity of earthy matter which is now deposited within the area of the delta. Dr. Riddell communicated to me the result of a series of experiments which he had made, to ascertain the proportion of sediment contained in the waters of the Mississippi. He concluded that the mean annual amount of solid matter was to the water as $\frac{1}{1245}$ in weight, or about $\frac{1}{3000}$ in volume. Since then he

has made another series of experiments, and his tables show that the quantity of mud held in suspension increases regularly with the increased height and velocity of the stream. On the whole, comparing the flood season with that of clearest water, his experiments, continued down to 1849, give an average annual quantity of solid matter somewhat less than his first estimate, but not varying materially from it. From these and other observations on the average width, depth, and velocity of the river, the mean annual discharge of water and sediment was deduced. I then, (1846) assumed 528 feet, or the tenth of a mile, as the probable thickness of the deposit of mud and sands in the delta; founding my conjecture chiefly on the depth of the Gulf of Mexico between the southern point of Florida and the Balize, which equals, on an average, 100 fathoms, and partly on some borings 600 feet deep, in the delta near Lake Pontchartrain, in which the bottom of the alluvial matter is said not to have been reached. The area of the delta being about 13,600 square statute miles, and the quantity of solid matter annually brought down by the river 3,702,758,400 cubic feet, it must have taken 67,000 years for the formation of the whole; and if the alluvial matter of the plain above be 264 feet deep, or half that of the delta, it must have required 33,500 years more for its accumulation, even if its area be estimated as only equal to that of the delta, whereas it is in fact larger.

From information since received, especially from some observations made by Mr. Slidell during a government survey, which would lead to the inference that the average number of cubic feet of water discharged into the Gulf per second is considerably greater than was allowed in the above estimate, I think it not improbable that the time assigned is somewhat too long, as a larger quantity of sediment would be brought down in a given time. But, on the other hand, it must be remembered, that the delta is a mere fragmentary portion of a larger body of mud, the finer particles of which never settle down near the mouths of the Mississippi, but are carried far out into the Gulf, and there dispersed. Many circumstances, indeed, make me doubt whether the larger portion of that impalpable mud, which constitutes the bulk of the solid matter carried into the sea by the river, is not lost altogether, so far as the progress of the delta is concerned. So impalpable is the sediment, and so slowly does it sink, that a glass of water taken from the Mississippi may remain motionless for three weeks, and yet all the earthy matter will not have reached the bottom. If particles so minute are carried by the current, setting for a great portion of the year from west to east, across the mouth of the river, into the Gulf Stream, and so into the Atlantic, they might easily travel to the banks of Newfoundland before sinking to the bottom, and some of them, which left the head-waters of the Missouri in the 49th degree of north latitude, may, after having gone southward to the Gu f, and then northward to the Great Banks, have found no resting-place before they had wandered for a distance as great as from the pole to the equator, and returned to the very latitude from which they set out.

The age of stumps and erect trunks of the deciduous cypress, whether living or buried, retaining their natural positions at points near the present termination of the delta, ought to be carefully examined, as they might afford evidence of the minimum of time which can be allowed for the gain of land on the sea. Some single trunks in Louisiana are said to contain from 800 to 2,000 rings of annual growth, and Messrs. Dickeson and Brown show that in some filled-up cypress basins, 4,000 years must have passed since the first cypress-tree vegetated in them.

After considering the age and origin of the modern deposits of the Mississippi and its tributaries, we have still to carry back our thoughts to the era of the fresh-water strata seen in the bluffs which bound the great valley. These in their southern termination have evidently formed an ancient coast line, beyond which the modern delta has been pushed forward into the sea. From the loam at Natchez and in other localities, from the remains of associated terrestrial animals, and from the buried trees at Port Hudson, we have inferred that these deposits are the monuments of an ancient alluvial plain of an age long anterior to that through which the Mississippi now flows, which was inhabited by land and fresh-water mollusca, agreeing with those now existing, and by quadrupeds, now for the most part extinct.

In my former work I described some ancient terraces occurring in the valley of the Ohio, and pointed out that the included fossil-shells demonstrate the fluviatile and modern origin of the deposits, and suggested that their present position could only be explained by supposing, first, a gradual sinking down of the land, after the original excavation of the valley, during which period the gravel and sand were thrown down, and then an upheaval of the same valley, when the river cut deep channels through the fresh-water beds. By simply extending to the valley of the Mississippi the theory before applied to that of the Ohio, we may account for the geological appearances seen in the larger and more southern area.

In regard to the time consumed in accomplishing the great oscillation of level, which first depressed so large an area to the depth of 200 feet or more, and then restored it to its former position, it is impossible, in the present state of science, to form more than a conjecture as to the palpable mean rate of movement. To suppose an average sinking and upheaval of two and a half feet in a century, might be sufficient, or would, perhaps, be too great, judging from the mean rate of change in Scandinavia, Greenland, the north of the Adriatic, and other regions where similar changes are now going on, or have been so recently. Even such an oscillation, if simultaneously continuous over the whole area, first in one direction, and then in another, and without any interruptions or minor oscillations, would require 16,000 years for its accomplishment. But the section at Cincinnati seems to imply two oscillations, and there would probably be pauses, and a stationary period, when the downward movement ceased, and was not yet changed into an upward one. Nor ought we to imagine that the whole space was always in motion at once.—*Condensed from Lyell's Second Visit to the United* States.

RIVER TERRACES OF THE CONNECTICUT VALLEY.

AT the late meeting of the American Association, President Hitchcock, of Amherst College, read an interesting paper "On the River Terraces of the Connecticut Valley." He stated that his paper must be considered as containing a few facts and suggestions, and not a finished theory. He had examined the valley from its mouth to Turner's Falls, and carefully measured the heights of the terraces. "As you approach the river, you find plains of sand, gravel, or loam, terminated by a slope, sometimes as steep as 35°, and a second plain, then another slope and another plain, and so on, sometimes to a great number. I find that these terraces occur in successive basins, formed by the approaches of the mountains upon the banks, at intervals. Sometimes the basin will be 15 or 20 miles in width, but usually much narrower; and it is upon the margins of these basins that the terraces are formed. I have rarely found terraces more than 200 feet above the river; which would be, in Massachusetts, about 300 feet above the ocean, and at Hanover, N. H., about 560 feet. Nowhere do they exist along any river, unless that river has basins. As to the materials of which they are formed, they appear exceedingly artificial. The outer or highest terrace is generally composed of coarser materials than the inner ones. All are formed of materials which are worn from the rocks, but the outer terrace oftener is full of pebbles, some of them as large as 12 inches, while the materials of the inner seem reduced to an impalpable powder, like the soil of a meadow which is overflowed during high water. Whence did these materials originate? They were first worn from solid rocks, and afterwards brought into these valleys. The outer terrace appears to have been often in part the result of the drift agency. Afterwards the river agency sorted the materials, and gave them a level surface, the successive basins having at that time barriers. The inner terrace appears to have been, at least in its upper part, the result of deposition from the river itself.

"I will now mention a few facts which I have observed. The terraces do not generally agree in height upon the opposite sides of the valley. The higher ones oftener agree, perhaps, than the lower ones. If formed, as I suppose, from the rivers, we should expect this. The terraces slope downward in the direction of the stream. The same terrace which, near South Hadley, is 190 feet above the river, slopes until, at East Hartford, it is only 40 feet above the river, thus sloping 150 feet more than the slope of the river itself, in a distance of 40 or 50 miles. This shows that they could not have been form by the sea or by a lake, for they would then have been horizont. The greatest number of terraces observed is eight or nine; generally there are but two or three." President H. enters much into detail, stating his theory of the formation of these terraces, with many facts in support of it. We have confined ourselves to his principal statements, as no abstract could give a correct idea of his views; and they are too long for insertion entire.

IDENTITY OF THE NUMMULITIC FORMATION WITH THE EOCENE TERTIARY.

SIR. R. I. MURCHISON, in a paper read before the Royal Geological Society of England, "On the Transitions between the Secondary and Tertiary Formations," shows that the vast formations of nummulitic limestone, which have generally been merged into the cretaceous strata, belong in reality to the eocene tertiary. This testimony of organic remains had previously referred these rocks to their true position, but it is only within a recent period that Mr. Murchison has been enabled to prove, from patient geological researches, that the nummulitic formation, when free from obscurities and unbroken, is in its superposition in harmony with the distribution of animal remains. The union of the nummulitic and cretaceous groups in one system has been almost exclusively based on the phenomena of both having undergone the same movements, and having been often elevated into the same peaks and ridges. This formation, says Mr Murchison, extends through the whole of Southern Europe, the Crimea, Africa, Egypt, and Hindostan, or, in other words, from the Carpathians to the mouth of the Indus, a space of not less than 25 degrees of latitude has been occupied by sea-basins, in which the creatures of this era lived. In accordance with these views, a great change must be made in geological maps and in the classification of these rocks in Southern Europe and other parts of the world.

GEOLOGY OF CHARLESTON, S. C.

FROM an article communicated to the March number of *Silliman's Journal*, by Prof. F. S. Holmes, entitled, "Notes on the Geology of Charleston," the following facts have been obtained:—That Charleston, the capital of South Carolina, is built upon Geological formations identical in age with, and in other respects similar to, those upon which the great cities of London and Paris are located, is a curious fact but lately ascertained. The basin-shaped depression of its underlying calcareous and other beds, as determined in the survey just made by Prof. Tuomey, occupies a considerable extent between the Savannah and Pedee Rivers, and rests upon an older group of rocks known to geologists as the cretaceous formation. The sides of this basin are estimated to be of sufficient inclination to produce those artificial fountains which are produced by boring, and known as "Artesian Wells," through which, by hydrostatic pressure, the water is forced up to, if not above the surface. This basin seems destined to become as famous in the eyes of the scientific world as that of Paris, from the number of new and interesting fossil remains with which it abounds, while those of them already exhumed claim for it a rank above that of the London basin. The explorations already made have brought to light portions of the bones and the grinders of the mastodon and numerous testacea. Descending below the post-pliocene formation, where these are found, is the eocene or lower tertiary, the first stratum being an olive-colored peaty substance, resting upon

another of sand, that separates it from the great marl-bed below This stratum contains a quantity of water, which, in the boring of the Artesian well, rose in the tube to within six feet of the surface, and greatly obstructed the progress of the auger by filling it with quicksand.

Embedded in the peaty substance before mentioned, are numbers of rolled and water-worn rocks of all sizes, from a few inches to a foot in diameter, in which is found the same form of fossils as is seen in the great marl-bed below,—of which, doubtless, these are fragments broken off by the action of the sea and rolled into boulder-like masses, their nature changed by some chemical process, whereby nearly all the lime has been extracted, and the casts of the shells left preserved in a silicious rock, emitting, when broken, a fetid odor. This stratum,—the cause of whose separation and separate deposit yet remains to be determined,—including the first ten feet of the underlying marl, may be properly called "zeuglodons" or "basilosaurus" bed of the Charleston basin, which Prof. Agassiz has pronounced the "richest cemetery of animal remains that he had ever seen." From it was taken the most perfect skull yet found of that wonderful gigantic fossil cetacean, and that by which was determined the true character of this singular animal. Isolated teeth and bones of Basilosaurus, Dinotherium, Methagerium, Equus, and nearly fifty species of sharks, are obtained in abundance. The number of undetermined teeth and bones is considerable. Two specimens of walnuts with the epidermis converted to lignite; three casts of hickory-nuts, very perfect and beautiful; and fragments of wood (now lignite), bored by the Teredo, whose casts in marl are yet preserved, have been also obtained; and, says Prof. Holmes, at every visit something new is added to my stock.

ANCIENT AND PRESENT CLIMATE OF ICELAND.

A German traveller, Walterhausen, has recently published some sketches of Iceland, with especial relation to its volcanic phenomena, but he details many other interesting facts. Of the climate he says, that, "though of course in the main determined by its geographical position, it is considerably modified by the character of the neighbouring seas and the currents prevailing in them. In the *surturbrand* (a sort of bituminous coal existing in large beds) there are found well-preserved impressions of the leaves of the oak, willow, and beech. Steenstrup, who visited the island, on a commission from the Danish government, in 1838, found in some of the tuff strata the impressions of ten different kinds of trees of extinct species, which may be compared to those found in Canada and the United States. The leaves of the birch, willow, elm, maple, and liriodendron, as well as the cones and needles of various coniferæ, place this view beyond a doubt." They are found in positions which show that they could not possibly have drifted thither, but that they must have grown on the island, so that a milder climate must have prevailed during the tertiary period than at present. Similar conclusions may be drawn from

the fossil mollusca. The author, however, rejects entirely the hypothesis of an ice period, and is very severe on its supporters.

One curious fact with respect to the present climate of Iceland is, that it is, in most years, the opposite of that of the European continent. While the winter of 1844–45 was remarkably long and severe in Europe, it was in Iceland unusually mild. The summer of 1845 was fine and dry in Iceland, rainy and cold in central Europe. Great inconstancy of weather is characteristic of the climate, and a calm tranquil air is the greatest of rarities, while storms of terrific violence are very frequent. The author mentions one in which a companion of his was blown off his horse, and the wind, in sweeping over the fiord, raised clouds of spray that reached them at a height of 2,000 feet above the water.

VOLCANOES NO SAFETY-VALVES.

At the meeting of the American Association, August, 1849, a paper on the "Isolation of Volcanic Action in the Sandwich Islands, or Volcanoes no Safety-Valves," was read by Professor James D. Dana. The observations presented were made during the cruise of the Exploring Expedition under Captain Wilkes, and have an important bearing upon the theory of volcanic action.

The island of Hawaii has an area of about 38,000 square miles, and contains three lofty volcanic cones, or domes. The principal one is Mount Loa, occupying the southern portion of the island, and being, according to the observations of Captain Wilkes, about 14,000 feet high. It has at its summit a large pit-like crater, somewhat elliptical in shape, with its diameters 13,000 and 8,000 feet, and a depth of 784 feet. There are no thin walls around it, as about Vesuvius; it is like a vast excavation in the wide summit-plain. Through fissures in the bottom of the pit, vapors are constantly rising, and at times the action is intense, and eruptions take place.

Besides the summit-crater of Mount Loa, there is also a still larger one, Kilauea, situated on the southeastern slopes of Mount Loa, about 4,000 feet above the level of the sea. It is an amphitheatre of rock, 7½ miles in circuit, and 3¼ in longest diameter, with a depth of 1,000 feet, large enough, in fact, to hold 400 such structures as St. Peter's at Rome. The bottom plane is 2¼ miles long and averages ¾ of a mile in width. In the ordinary state of the volcano all seems remarkably quiet. When visited by Mr. Dana, six months after the eruption in 1840, there were wreaths of vapor rising from a few parts of its inside surface, and in three places the red-hot lavas were in constant ebullition. One of these lakes of lava measured 1,000 by 1,500 feet in its diameters. Over its surface jets were constantly playing, precisely like jets over a boiling caldron of water; yet larger in the viscid fluid, for they rose to a height of 40 to 60 feet. At other times Kilauea is in full ignition throughout the larger part of its vast interior; the caldrons are more numerous and extensive, and there are many spouting cones accompanied with detonations. These

boiling pools in the bottom of Kilauea show no sympathy in their conditions; one may sink 100 feet, while another is overflowing; the smaller pools may boil at their ordinary level and overflow, when the large lake, 1,000 feet in diameter, has sunk 100 or 150 feet below the bottom plain of Kilauea.

Again; although the pit Kilauea is 600 to 1,000 feet deep (the depth varying with its different phases), eruptions sometimes take place through the very top of its walls, so that lavas will at times come to the very brink of the pit, and flow back again; and this, too, while the great pools of lava are open hundreds of feet below, and in constant ebullition. When in 1843 an eruption took place from the summit of Mount Loa, and streams of lava for a whole month flowed out in different directions for a distance of twenty-five miles, Kilauea boiled at its usual rate, without the slightest disturbance or signs of change, or appearance of sympathy. Missionaries who visited it when the crater at its summit was in full activity, report that perfect quiet and undisturbed regularity prevailed in Kilauea. It is a surprising fact, that eruptions should take place at an elevation of 13,760 feet, when, on the slopes of the mountain, sixteen miles distant, there is an open vent like Kilauea, more than three miles in length, and 10,000 feet lower in elevation. Why is there no relief here for the vast accumulation of pressure? This pressure, when the central conduit is filled to the summit, amounts to 17,200 pounds to the square inch. How is it that the wide, open passage, which Kilauea appears to present, affords no escape for the imprisoned lavas? How is it possible, if the two great conduits, that of the centre of Mount Loa, and that of Kilauea, intercommunicate,—how is it possible that the heavy rock fluid stands 10,000 feet higher in one leg of the syphon than in the other? It is certainly difficult to conceive how the ordinary principles of hydrostatics can be so set aside. From the quiet character of the eruptions, it is apparent that there was no paroxysmal elevation of the lavas to the summit; it was a slow and gradual result.

Whatever mode of solving the difficulty be adopted, one conclusion is evident—*volcanoes are no safety-valves of the globe*, although often so called. Assuredly, if, while a vast gulf is open on the banks of Mount Loa, lavas still rise and are poured out at an elevation of 10,000 feet above it, Kilauea is no safety-valve even to the area covered by the single mountain alone. If lavas may be ejected from the very lip of Kilauea while the pools are still boiling within it several hundred feet below, Kilauea, notwithstanding its extent, the size of its great lakes of lava, and the freedom of the incessant ebullition, is not a safety-valve that can protect its immediate vicinity. How, then, with so limited a protecting influence, can it relieve from danger a *neighbouring* island? How can the narrow conduit of a volcano relieve continents from the great earthquakes that sometimes traverse their whole extent?

Volcanoes are in fact indexes of danger; they point out those portions of the globe which are most subject to convulsions. Earthquakes and eruptions are often allied results of the same general cause. As the volcano becomes more active, the earthquakes of the region become more frequent: and the latter cease when quiet follows

an eruption. This is true, for the very plain reason that the volcano is the source of danger. When it approaches extinction the quiet is of longer and longer continuance; and as it dies out, a region once tottering on subterranean fires may finally enjoy the firm stability of lands that have never been favored with such "safety-valves."

VOLCANO IN NEW GRENADA.

"You will see upon my map of New Grenada, in latitude 10° 50′, longitude 78° [from Paris?] a place marked *volcano*. I placed it there because it was found on ancient maps, but I had my doubts of its existence. I have just returned from visiting it, and have been astonished by the phenomena there exhibited. The cape or promontory of Galera-Zamba formerly extended into the sea without interruption to the island of Enea, which formed its extremity. One could then travel three or four leagues by land, and in less than an hour after leaving the coast he saw a conical peak, which was a true volcano terminated by a crater, from which gas escaped with sufficient force to hurl into the air wood thrown into it. The volcano from time to time sent forth smoke, which rendered it an object of fear to the inhabitants, who dared not approach it. About ten years ago, after an eruption accompanied with flames, the earth gradually subsided, and the peninsula of Galera-Zamba became an island, so that coasting vessels passed through the opening left, which was found to be eight or ten metres* deep. This was the state of things at the beginning of October, 1848. On October 7, 1848, about two o'clock in the morning, a noise was heard which increased rapidly, and at once there issued from the sea in the place of the old volcano, a luminous sheaf, which lighted up the country for thirty leagues on all sides. No showers of ashes were observed, nor was any earthquake felt during this eruption, which lasted several days, but with a decreasing intensity. Some days after the eruption, an island covered with sand was observed in the spot where the volcano had been. No one dared to land upon it, and in a few weeks it subsided. Fish are now taken within the ancient crater, showing that there are no destructive exhalations at present. Thus we must add another volcano to the list of the active ones, for the volcano of Zamba, which has given signs of activity within twelve months, cannot be considered extinct."—*Col. Acosta, in the Comptes Rendus, Nov.* 20.

ERUPTION OF A VOLCANO IN JAVA.

A LETTER from Batavia (Java), of the 26th of September, gives some account of a late eruption of Mount Merapia, a volcano in the district of Kadoe, believed to be extinct. The eruption began on the morning of the 14th of September, during a violent hurricane, and lasted until the evening of the 17th, that is to say, more than three days. The mountain vomited forth gigantic flames and large quantities of

* A metre equals 39.37 inches.

stones and ashes. This matter, impelled by the action of the wind, was spread through the whole district of Kadoe, and also those of Djokjokarta and Surakarta. At several points the soil was covered with ashes to the depth of three inches. The river of Blongkeng was almost wholly filled up, and it is feared that its waters must overflow in the rainy season. The inhabitants fled and no life was lost; but the loss of property, including crops of rice, tobacco, and indigo, with whole fields of corn, was immense.

OBSERVATIONS ON THE OLD CRATER OF KILAUEA, SANDWICH ISLANDS.

THE following observations on the old crater of the volcano Kilauea, Sandwich islands, were communicated to *Silliman's Journal* for March, by Rev. C. S. Lyman:—"The old crater is a pit a mile in diameter, and five or six hundred feet deep, separated from the present active crater by an isthmus of earth, about a quarter of a mile in width. The bottom is covered with lava in thick strata, resembling ice in the bottom of a pond after the water has been drawn out. This covers an area three quarters of a mile in diameter, and rises around the sides of this bowl-like concavity some forty or fifty feet above the level of the bottom. Projecting perpendicularly from the bottom are great numbers of stone pillars of various sizes, from one to two feet, and of heights from one to twenty feet. These pillars are tubular, and filled with charcoal. The origin of these pillars I take to be this. At some comparatively recent period, the lava burst out far up the sides of this pit, and even upon the neck of land between the two craters, and flowed down into the bottom,—at that time a forest,—filling it up to the depth of forty or fifty feet with a lake of lava. The lava in contact with the trees would be cooled at once into an incasement of stone, from two to six inches in thickness, while the rest of the mass remained fluid. The trees would of course be almost instantly reduced to charcoal, and a crust often a foot or so in thickness must have cooled on the surface of the lake. The lake must then have been drained off subterraneously, while the crust, descending, like the ice on a pond when drawn off, would be pierced by these solid encasements of the trees, and finally lie scattered over the bottom in huge cakes, as ice would among stumps on the bottom of the pond, leaving these curious tree-encasements projecting as they now do."

CURIOUS EFFECTS OF TRAP DIKES ON MAGNESIAN LIMESTONE.

IN the *Philosophical Magazine*, some curious effects of the intersection of magnesian limestone beds by dikes of greenstone, occurring in the island of Bute, are described by Mr. James Bryce. The limestone is rendered saccharine in texture, having a crumbling character adjoining the dike, but hard a short distance off. By analysis it was found that the unaltered rock contained twenty per cent. of carbonate of magnesia, while the part altered by the dike contained only from one

to three per cent. The author inquires, "To what cause are we to assign the changes that have taken place? Has the magnesia been sublimed by heat? or has it been withdrawn by the solvent power of free carbonic acid? The subject is one of great interest, both to the geologist and chemist, as the facts are directly opposed to the received views, and as no instance of similar changes on dolomitic rocks has, so far as I am aware, been put on record."

DECOMPOSITION OF ROCKS.

M. Ebelmen, at the conclusion of a memoir on this subject, examines one of the most important questions relating to the natural history of the globe,—that of the relations which *necessarily* exist between the phenomena of the alteration of rocks, and the composition of atmospheric air. "The different bases which separate from the silex by the decomposition of igneous rocks determine, in fact, the precipitation, the mineralization of the oxygen and of the carbonic acid; the last element in particular is absorbed in great quantity, and a simple calculation shows that a small body of decomposed plutonic rocks is sufficient for the complete precipitation of the carbonic acid contained in the air. Now, the argillaceous bed of stratified formations induces the decomposition of immense masses of plutonic rocks; and, consequently, the precipitation of quantities of carbonic acid out of all proportion with those actually existing in the atmosphere. This result may be explained without any necessity of admitting that the air has possessed, in the different geological epochs, a very different composition from that which it now presents.

"I observe in volcanic phenomena," says M. Ebelmen, "the principal cause which restores to the atmosphere the carbonic acid which the decomposition of rocks continually precipitates from it. We know that this gas is disengaged in abundance from the ground in the neighbourhood of active volcanoes, and even from extinct volcanoes. It is interesting to witness the formation of igneous rocks, accompanied with the disengagement of a gas, which the destruction of these same rocks will precipitate. The central heat of the globe will, therefore, be indispensable for the maintenance of organic life on its surface. The beautiful experiments of Saussure on the influence of the carbonic acid of the air on the nourishment of vegetables, are no longer sufficient to explain the permanence of the composition of atmospheric air. We see that phenomena entirely of a different kind must be introduced for the solution of the question, and that the mineral elements of the crust of the earth likewise concur, by the inverse reaction, the one on the other, to produce this equilibrium."—*L'Institut.*

THE DEAD SEA.

The following interesting facts are from Lieutenant Lynch's Official Report of the Exploring Expedition to the Dead Sea:—

"The bottom of the northern part of the Dead Sea is almost flat (a *plain*). The meridional lines at a short distance from the shore vary but

little in depth; the greatest depth found up to the date of this letter (May 3d) was 188 fathoms, or 1,128 English feet. Near the shore the bottom is generally a saline incrustation, but the intermediate portion is of soft mud, with several rectangular crystals,—most frequently cubes of pure salt. On one occasion we obtained only crystals with the lead line.

"In the same proportion that the north part of the Dead Sea is deep, so is the southern part shallow, to the extent that for a quarter of its length the depth was found to be but 18 feet. Its southern bed presented no crystallizations, but its shores are covered with incrustations of salt, and, on landing, the footmarks in an hour's time were covered with crystallizations. The shores in face of the peninsula, and its western side, present evident marks of destruction. Birds and insects are, without doubt, to be found on the shore; sometimes ducks on the sea, for we saw some, but we could find no living object in the sea. However, the salt sources it receives contain fish belonging to the ocean. I feel certain," says Lieutenant Lynch, "that the result of our expedition will confirm to the very letter the history of the Holy Land, as regards the sunken cities.

"After the examination of the Dead Sea, the expedition proceeded to determine the height of the mountains, and the level of a plain, from Jerusalem to the Mediterranean Sea. They found the summit of the western coast of the Dead Sea more than 1,000 feet above its surface, and level with the Mediterranean. It is a singular fact, that the distance from the top to the bottom of the Dead Sea,—that is, the height of its shore,—the elevation of the Mediterranean, and the difference of the level between the bottom of these two seas, and the depth of the Dead Sea, should thus be an exact multiple of the elevation of Jerusalem above it. Another fact, not less curious, is, that the bottom of the Dead Sea forms two sunken plains,—one elevated, the other depressed. The first part, south, is composed of clay or fat mud, covered by an artificial bay; the latter, the upper part, and more north, of mud incrustations, and rectangular salt crystallizations, extending to a great depth, and with a narrow ravine defiling in the midst of it, corresponding with the Jordan at one extremity, and Wady Seib at the other.

"On one occasion Mr. Aulick sounded directly across, and found the width of the sea by patent log to be a little more than eight geographical, or about nine statute miles."

PILLAR OF SALT ("LOT'S WIFE").

"APRIL 26. At nine, the water shoaling, hauled more off shore Soon after to our astonishment, we saw on the eastern side of Usdun [in the southern part of the sea], one third the distance from its north extreme, a lofty round pillar, standing apparently detached from the general mass, at the head of a deep, narrow, and abrupt chasm. We immediately pulled in for the shore, and Dr. Anderson and I went up and examined it. The beach was a soft, slimy mud, incrusted with salt, and a short distance from the water, covered with saline frag-

ments and flakes of bitumen. We found the pillar to be of solid salt, capped with carbonate of lime, cylindrical in front and pyramidal behind. The upper or rounded part is about 40 feet high, resting on a kind of oval pedestal, from 40 to 60 feet above the level of the sea. It slightly decreases in size upwards, crumbles at the top, and is one entire mass of crystallization. A prop, or buttress, connects it with the mountain behind, and the whole is covered with debris of a light stone color. Its peculiar shape is doubtless attributable to the action of the winter rains. A similar pillar is mentioned by Josephus, who expresses the belief of its being the identical one into which Lot's wife was transformed. Clement of Rome, a contemporary of Josephus, and Irenæus, a writer of the second century, also mentions this pillar."—*Lynch's Expedition to the Dead Sea.*

GEOLOGY OF SCINDE, BRITISH INDIA.

No sooner was the conquest of Scinde, India, effected, than a geological investigation of the newly acquired province was immediately commenced under the orders of Sir Charles Napier. Under his auspices the exploration of the countries on the right bank of the Indus, including the Hala and Solyman mountains, has been successfully accomplished, and the results communicated to the Royal Geological Society of London. By means of copious collections of fossils transmitted to England, Sir R. I. Murchison has ascertained that these rocks of the Indus, which extend over the greater part of the Punjaub and the valley of Cashmere, belong to the same great nummulitic formation which occupies so vast a space in Southern Europe, and which, ranging from the Pyrenees and Alps, through Egypt, Asia Minor, and Persia, as far as Hindostan, is of the true older tertiary, or eocene age. To the north of Delhi, a considerable tract of the sub-Himalayan hills, which there skirt the great plain of Hindostan, has been explored minutely. The existence of nummulitic rocks, as in Scinde and Beloochistan, was here also developed, overlaid on their lower flanks by more recent tertiary deposits, loaded with fossil bones of mammalia, tortoises, and crocodiles.

GEOLOGY OF THE PACIFIC.

The following extracts are taken from Mr. Dana's recently published "Geology of the Exploring Expedition."

The Pacific Ocean exceeds by ten millions of miles the area of all the continents and islands on the globe: over this wide void are scattered about six hundred and seventy-five islands, whose united area, excluding New Zealand, New Caledonia, the Salomons, and a few other large islands, is only forty thousand square miles (less than the State of New York). Yet this small space presents the sublimest and most beautiful scenery in the world, and supports the richest tropical vegetation. No native land quadruped, however, is found in the whole ocean.

Most of the islands lie within the tropics, and, in all, the groups are

arranged in linear directions, like the summits of mountain ranges. "Could we," says our author, "take a birdseye view over the 6,000 miles between New Holland and Mexico, we should see some of the most extensive mountain chains in the world; the Samoan, stretching over its 3,800 miles, the Hawaiian its 2,000, and others no less remarkable, all preserving a systematic regularity which seems even to exceed the systematic regularity of continental chains. The height of summits in these chains, measured from the bottom of the ocean, would exceed the most majestic peaks of the Himalaya range. Even allowing but three miles for the depth of the sea near Hawaii, Mount Loa will stand 30,000 feet above its base."

The islands of the Pacific are either coral, or basaltic (which includes the volcanic), or continental, i. e. of a mixed character, like continents. The coral islands number about 290; the basaltic about 350,—not counting the many green spots large enough for a village site, or a grove of palms, which occur on the reefs that surround the high islands. The principal coral islands are the large archipelago northeast of the Society Islands, called the Paumotu group, and the Carolines; though there are many single ones scattered over the ocean, and reefs of coral about most of the principal islands.

Coral reefs are barriers of coral rock, varying from a few hundred feet to miles in width, extending around other islands, sometimes continuously, at others broken, and at irregular distances from shore. Generally there is an outer and an inner reef; these are termed the *barrier* and the *fringing* reef. The barrier reefs rise usually but a little above low-tide level; sometimes there is shallow water for two or three miles beyond them, but more frequently the ocean is unfathomable within a few hundred feet of them. The exposed edge is a few inches higher than the general surface, and presents a smooth, water-worn appearance, as might be expected from its never-ending conflicts with the long surges of the Pacific. Sometimes the outer reefs accumulate coral fragments and sand, until they widen into islands. The coral of the reef rock is not found in its original position of growth; it is composed of the *débris* of coral consolidated by a calcareous cement, and often contains, besides corals, shells and fossils of the seas where it is found, resembling in appearance the limestone of the neighborhood of Cincinnati and the Falls of the Ohio.

Within the outer reefs, corals are found growing in their greatest perfection. These inner reefs bear great resemblance to the outer in structure, though their forms are much less modified by the action of the waves. "There are many regions,—in the Feejees examples are common,—where a remote barrier incloses as pure a sea as the ocean beyond, and the greatest agitation is only such as the wind may excite on a narrow lake or channel." Generally, the rock of these inner reefs is composed of coral, which stands as it grew, less fragmentary than the outer, but united by a solid cement. Upon its surface the limits of the constituent masses may be often distinctly traced. The corals grow underneath the surface in solid hemispheres, but when the surface is reached the top dies, and enlargement only goes on at the sides. "Some individual specimens of Porites in the rock of the

inner reef of Tongatabu were 25 feet in diameter; and Astreas and Meandrinas, both there and in the Feejees, measured 12 to 15 feet."

Sometimes the barrier reef recedes from the shore, and forms wide channels or inland seas where ships find ample room and depth of water, exposed, however, to the danger of hidden reefs. The reef on the northeast coast of New Holland and New Caledonia extends 400 miles, at a distance varying from 30 to 60 miles from shore, and having as many fathoms of depth in the channel. West of the large Feejee Islands the channel is in some parts 25 miles wide, and 12 to 40 fathoms in depth. The sloop-of-war Peacock sailed along the west coast of both Viti Lebu and Vanua Lebu, within the inner reefs, a distance exceeding 200 miles.

A barrier reef, inclosing a lagoon, is the general formation of the coral islands, though there are some of small size in which the lagoon is wanting. These are found in all stages of development; in some the reef is narrow and broken, forming a succession of narrow islets with openings into the lagoon; in others there only remains a depression of surface in the centre to indicate where the lagoon originally was. The most beautiful are those where the lagoon is completely inclosed, and a quiet lake rests within.

These islands evidently rise abruptly out of the unfathomable depths of the ocean, for, in speaking of one of them, Mr. Dana says,—"Seven miles east of Clermont Tonnere, the lead ran out to 1,145 fathoms (6,870 feet) without reaching bottom. Within three quarters of a mile of the southern point of this island, the lead, at another throw, after running out for a while, brought up an instant at 350 fathoms, and then dropped off again and descended to 600 fathoms without reaching bottom." Several similar soundings are recorded by Mr. Dana.

Another peculiarity of them is the small amount they present of habitable surface. They are but narrow and often interrupted borders, just cutting out a certain part of the ocean. In the Marshall Islands the dry land is not more than the one hundredth part of the whole; and in the Pescadores the proportion of land to the whole area is about 1 to 200. The lagoons are generally shallow, though in the larger islands soundings gave 20 to 35, and even 50 and 60 fathoms.

Mr. Dana gives full descriptions of the various species of coral zoöphytes, their mode and probable time of growth, &c., most of which present few facts susceptible of condensation. One error, however, it may be well to insert his correction of. The coral is not built by the polypi, but is simply the natural secretion which belongs to them, as the shell of the oyster does to it. It is not, however, a shell for defence into which the animal withdraws itself, it being formed entirely *within* its living and fleshy part. There are polypi which secrete no lime or coral, in every other respect similar to those which do. They grow upon rocks, and are provided with tentacula to secure their food. They increase by buds which shoot out from their sides. In coral formations the buds spread out so thickly as to stop the life within, and hence, as the process goes on, all is dead mass, except just at the surface. The most extensive family of these zoö-

phytes constitutes in science the order of Actinoidea, a name given on account of their radiated or star-like shape. All the varieties are found in the greatest luxuriance in the waters of the Feejee group. None were found growing deeper than 20 fathoms.

Mr. Dana mentions the various theories which have been proposed to account for the form and origin of these coral islands, but that adopted by him is the one advocated by Dr. Darwin. He supposes the peculiar form of the reefs to arise from their being built around heights of land, which, by some change in the economy of nature, has gradually subsided. If we suppose a large island or continent to sink, so that the mountains should only remain above the surface, they will, it is clear, form islands, around which the coral zoöphyte, which never vegetates below 20 fathoms, will begin its fringe or reef. Let the change of level go on as before, the land, year by year, becoming more and more submerged, and the reefs will draw inwards around the high peaks, and finally, as they go under, will still remain a ring above them with a lagoon; for the animal could not work in the middle until the whole was submerged, and even then prefers the open ocean. This process going on for ages, so satisfactorily explains all the peculiarities of form found in the coral islands, that it is not easy to avoid the belief that this is the true supposition.

Leaving the coral islands, Mr. Dana next speaks of the Hawaiian group, and his account of them is no less interesting than that of the coral islands. The eight islands of the Hawaiian group lie between 19 and 22½° north latitude. They are Hawaii, Maui, Kahoolawe, Lauai, Molokai, Oahu, Kouai, and Niehau. They extend in a curved line 400 miles, and, including the small islets of Necker and Bird, and some coral reefs which properly belong to them, nearly 2,000 miles. They would appear to be the summits of two parallel ranges of mountains or volcanic centres, of which the volcanoes Mount Loa and Mount Kea, in Hawaii, are the southeastern extremities. These mountains are of nearly equal heights; Loa, according to the measurements of the expedition, is 13,760 feet above half-tide; Kea, 13,950. Mount Hualalai, on the same island, is about 10,000 feet. On Maui, next to the west, Haleakala 10,217 feet, and Eeka 6,130 feet. Oahu has two ranges 4,000 feet, and the summit of Kaui is 8,000 feet.

Hawaii is nearly triangular in form, its three sides fronting west 85 miles, southwest 65, and northwest 75 miles; its area is 3,800 square miles. Its whole surface is made up of the cones of its three mountains, whose slopes are so gentle that the eye scarcely perceives their altitude. In a tour around the island Mr. Dana found the surface to consist chiefly of broad fields of various leaves covered sometimes with a thin soil and dwarf forests, and with occasionally intervening patches under cultivation where the natives raise taro and yams. Sometimes the lava would be smooth and solid; at others, in fields of scoria and lava in immense masses heaped together in the wildest confusion. These are called *clinker fields*, and are caused by the lava in its flow melting some obstruction, and cooling and hardening on the surface; then bursting out afresh and rending the crust into fragments,—like

the breaking up of ice in the spring, but on a much grander scale, the stream of lava being five or ten miles in width, and in place of smooth ice, shaggy heaps of black scoria many yards in thickness. These clinker districts are often several miles in breadth, and upon some of them the whole horizon around is one wide waste of gray and black desolation beyond the power of words to describe. In the winter Mount Kea is covered with snow, while Loa, owing probably to the internal fire, is almost bare.—*N. Y. Literary World.*

A NEW THEORY OF THE EFFECT OF THE TIDES.

Among the discoveries in science recently made on this side of the ocean is one which has excited much attention and interest among geologists and navigators; we mean the tide-theory of Lieutenant Davis, U. S. N., first presented at the meeting of the American Association in September, 1848. The following sketch of the principal results at which Lieutenant Davis has arrived was prepared by Mr. Desor, for *Silliman's Journal.*

The eastern coast of the United States is bordered throughout its whole extent by a line of sand-banks and islands of various forms and outlines, but very uniform in their mineralogical character, being composed of a very fine white and quartzose sand. On the coasts of the Southern States, they form a line of low islands separated from the coast by a series of lagoons, which give a peculiar character to the navigation of those districts.

Higher up, on the southern coasts of New England, they occur as submarine ridges, parallel to the coast, and separated from each other by wide channels. Farther north, these deposits are more extensive, and form vast submarine plateaus, such as the St. George's and Newfoundland Banks. Finally, deposits analogous to these are formed at the bottom of bays, but in a state of more complete trituration. These are known under the name of *flats.*

Mr. Davis, after having devoted several years to the study of these various species of banks, has arrived at this result: *that their forms, extent, and distribution are principally determined by tides*;—the wind and the waves playing but a subordinate part in their formation. One of the first points on which Mr. Davis insists is the relation that exists between the strength of tides and the distribution of sand-banks. On both sides of the Atlantic we invariably find sand-banks most numerous where the tides are slight, or where their force is exhausted after having been considerable. Mr. Davis accounts for this in the following manner:—According to the researches of Mr. Whewell, the tidal wave, on entering the Atlantic Ocean, passes onward in the form of an arc; the convexity of which is turned toward the north. In its progress northward, this wave strikes against the coasts of the two continents of Africa and America. From this shock proceed the various local currents which are designated under the name of tidal currents, the direction and rapidity of which are determined by the shape of the coasts. Their rapidity is, in general, in proportion to the directness of the obstacles opposing them, and the narrowness of the

channels through which they run. These tidal currents, in running with great rapidity along a coast, raise up and carry with them the movable deposits and the detritus of all sorts which the waves and atmospheric forces have detached from the beaches. These currents, however, soon lose their force, unless new obstacles come in their way; and in proportion as they abate, the substances held suspended, begin to be deposited. Any inequality of the bottom is then sufficient to form the nucleus or point of departure of a sand-bank, the direction of which will be parallel to that of the current. Such, for instance, is the origin of the narrow banks bordering the island of Nantucket, and known under the names of Bass Rip, Great Rip, South Shoal, &c.

But the most favorable conditions for the formation of sand deposits exist where the tidal current, after passing a promontory, is deflected laterally into a wide bay, where it can expand freely. Not only the heavy materials, but also the more minute particles, are then deposited at the bottom of the bay; no longer under the form of narrow ridges, but as broad continuous strata or *flats*, generally composed of very fine sand, or of calcareous mud, where the deposit takes place in the neighbourhood of coral reefs. This is the reason why the most extensive and regular deposits are found at the bottom of wide bays. Cape Cod Bay, on the coast of Massachusetts, is cited by Mr. Davis as an example of this mode of deposition. On the contrary, when the bay is narrow, as the *fiords* of Norway, or when it lies in the direction of the current, so as to allow the tide to rush in without obstacle and rise to a great height, as, for instance, the Bay of Fundy, the ebb and flood are too violent, and occasion too rapid currents to allow the water to deposit any of the materials which it holds suspended. Hence it is, that such bays are generally without sand-banks, unless it be in their lateral coves.

A remarkable phenomenon takes place when the tidal current flows with a moderate rapidity along a coast, so as to deposit a bank of sand against the cliffs. In this case, it is not unusual to see the bank stretching out into the sea, but, instead of following the direction of the coast, it inclines, from the pressure from without, towards the interior of the bay, so as to describe a bend, which the seamen of this country call a *Hook*. Sandy Hook, in the bay of New York, is of this character. Such, also, are the Hook of Cape Cod and the Hook of Holland. The direction of the Hook is invariably that of the current.

The coasts of Europe offer numerous examples of these various forms of alluvial deposits. Lines of narrow banks, like those on the coasts of New Jersey and the Carolinas, occur on the southwestern shores of France. On the northwestern coasts of France sand-banks are rare, but no sooner do we quit the Channel, than we find them scattered through the North Sea. Holland is, itself, formed in a great measure of alluvial sand. These deposits are formed precisely on the spot most favorable to the formation of alluvial deposits, namely, where the tidal current, having passed through the Channel, enters the vast basin of the North Sea.

Considered in their general connection, the alluvial deposits of a continent should be looked upon as the product of a series of currents

and eddies alternating with each other, the final result of which is to transport, in the direction of the flood, the movable materials which the waves and atmospheric agents have detached from the coast-beaches. This is particularly striking on the coast of the United States. The alluvial deposits form, at first, only a narrow line on the coast of Florida; this line enlarges insensibly on the coasts of the Carolinas, Virginia, and New Jersey; it becomes wider on the coast of Massachusetts, and finally attains the maximum of development in the Grand Banks of Newfoundland.

This process is of the highest importance in the economy of nature, if we consider that the banks thus formed are the principal seats of animal life in the ocean. It is upon the banks which border the coast of the United States that the most important fisheries are carried on, because these are the abodes of myriads of invertebrate animals (worms, mollusks, and zoöphytes), which serve for the food of fishes, while the great depths of the ocean, at a short distance from the banks, are almost deserts.

The tides are not less important, from the manner in which they influence river-deposits. Hitherto, the formation of deltas, such as those of the Mississippi, the Nile, the Orinoco, and other rivers, has been attributed too exclusively to the great quantities of mud which these rivers transport. It seems to be forgotten that other rivers, such as the Amazon, the Rio de la Plata, the Delaware, and others, are not less muddy, and yet, instead of forming deltas at their mouths, they empty into wide bays.

Mr. Davis, on the contrary, shows that deltas are in an inverse ratio to the tides, so that they exist only where the tides are feeble or null; whilst we find estuaries wherever the tides are considerable. Take, for example, the rivers of the eastern coast of the United States, and most of the rivers of Europe which empty into the Atlantic Ocean. And this is perfectly natural. The tide, on entering a river, accumulates during the flood, and keeps back the water of the stream, so that when the ebb begins, the water in escaping forms a current strong enough to carry off to sea the principal part of the materials held suspended in the river-water. Mr. Davis remarks on this point that, where bars exist in such estuaries, they are generally composed of sea-sand brought by the tide, and not of fluviatile deposits.

INFLUENCE OF TIDES ON ANCIENT GEOLOGICAL FORMATIONS.

In applying the principles of the tide-theory of Mr. Davis to the study of the deposits of former geological epochs, Mr. Desor states, "that it is easy to show, by a geological map of the United States, that the same laws which now regulate the deposition of sand-banks have been in operation during the diluvial, tertiary, and cretaceous epochs; the deposits of those epochs forming so many parallel zones successively following the great backbone of the Alleghanies.

"The diluvial deposits, in Europe as well as in America, merit a *special* attention in this respect. No doubt, during the diluvial

epochs, of the plains of Northern Germany as well as a great part of Scandinavia and on this continent, the coast of the United States, from Florida to Canada, formed a series of banks and shoals like the Banks of Newfoundland in our day, whilst the plains of the West, between the Alleghanies and the Rocky Mountains, formed a vast bay, comparable to the Gulf of Mexico, in which the sea deposited the fine sand and clay of the prairies, as it now deposits in the Gulf of Mexico the sand and mud that border the coast of Texas."

In conclusion, Mr. Desor remarks, that the sedimentary deposits of the most recent geological epochs, being, in all respects, like the alluvial deposits of our day, it is probable that they were formed under the operation of the same laws; and that the form and extent of continents, so far as they are composed of sedimentary deposits, are thus dependent on astronomical laws, that is, on the attraction which the sun and moon exert, and in all time have exerted, on the liquid part of our planet.

ON THE PHENOMENA OF THE RISE AND FALL OF THE WATERS OF THE NORTHERN LAKES.

At a meeting of the American Academy, February, 1849, Mr. Foster, of the United States Mineral Survey in the Northwest Territory, presented the result of some observations undertaken with a view of determining whether the waters of the Northern lakes are subject to any movements corresponding to tidal action. The result of these observations had convinced him that these waters do not rise and fall at stated periods, corresponding to the ebb and flow of the tide, but are subject to extraordinary risings, which are independent of the influence of the sun and moon. These risings attracted the attention of the earliest *voyageurs* in these regions. Charlevoix, who traversed the lakes nearly a century ago, says, in reference to Lake Ontario,—"I observed that in this lake there is a sort of reflux and flux, almost instantaneous; the rocks near the banks being covered with water and uncovered again several times in the space of a quarter of an hour, even if the surface of the lake was very calm, with scarce a breath of air. After reflecting some time on this appearance, *I imagined it was owing to springs at the bottom of the lake, and to the shock of their currents with those of the rivers which fall into them from all sides, and thus produce those intermitting motions.*" The same movements were noticed by Mackenzie, in 1789; by an expedition under Col. Bradstreet, in 1764; on Lake Erie in 1823, and at various later periods. In the summer of 1834 an extraordinary retrocession of the waters of Lake Superior took place at the outlet of Sault St. Marie. The river at this place is nearly a mile wide, and in the distance of a mile falls 18.5 feet. The phenomena occurred about noon. The day was calm, but cloudy. The water retired suddenly, leaving the bed of the river bare, except for a distance of thirty rods, and remained so for nearly an hour. Persons went out and caught fish in pools formed in the depressions of the rocks. The return of the waters is represented as having been very grand. They came

down like an immense surge, and so sudden was it, that those engaged in catching fish had barely time to escape being overwhelmed. In the summer of 1847, on one occasion, the water rose and fell, at intervals of about fifteen minutes, during an entire afternoon. The variation was from twelve to twenty inches, the day being calm and clear; but the barometer was falling. Before the expiration of forty-eight hours, a violent gale set in. At Copper Harbour, the ebb and flow of the water through narrow inlets and estuaries has been repeatedly noticed when there was not a breath of wind on the lake. Similar phenomena occur on several of the Swiss lakes. Professor Mather, who observed the barometer at Copper Harbour during one of these fluctuations, remarks:—"As a general thing, fluctuations in the barometer accompanied fluctuations in the level of the water; but sometimes the water-level varied rapidly in the harbour while no such variations occurred in the barometer at the place of observation."

As a general rule, these variations in the water-level indicate the approach of a storm, or a disturbed state of the atmosphere. The barometer is not sufficiently sensitive to indicate the sudden elevations and depressions, recurring, as they often do, at intervals of ten or twelve minutes; and the result of observations at such times may, in some degree, be regarded as negative. Besides, it may not unfrequently happen, that, while effects are witnessed at the place of observation, the cause which produced them may be so far removed as not to influence the barometer. We are, therefore, led to infer that these phenomena result, not from the prevalence of the winds acting on the water, accumulating it at one point and depressing it at others, but from sudden and local changes in the pressure of the atmosphere, giving rise to a series of barometric waves. The water, conforming to the laws which govern two fluids thus relatively situated, would accumulate where the pressure was the least, and be displaced where it was the greatest. It has been remarked by De la Beche, that a sudden impulse given to the particles of water, either by a suddenly increased or diminished pressure, would cause a perpendicular rise or fall, in the manner of a wave, beyond the height or depth strictly due to the mere weight itself. The difference in the specific gravity of the water of the lakes and the ocean may cause these changes to be more marked in the former than in the latter.

ON THE FALL OF RIVERS.

Mr. Augustus Petermann, in a paper read to the Geographical Society of London, communicates some interesting facts, which, he says, are "the result of laborious researches." "The fall of a river influences in part the velocity or force of its current, but not to such an extent that the rate of fall can be taken as a scale for the rate of the velocity and force of the current. We call the Danube, the Rhine, and the Elbe very rapid rivers, and they only exhibit a fall of 1 and 2 feet per mile; but we should not place the Tweed in the same rank of velocity, but in the lower part of its course it has an average fall of 8 feet, and yet it is freely navigated by small boats, while the

descent of only 2 feet in the Danube presents the greatest obstacles to navigation. It is obvious, therefore, that in treating of the fall of rivers, their depth and width should also be taken into the account." The River Dee, during the last 72 miles of its course, falls 1,190 feet or about 16½ feet to the mile, on an average; but it has not a single waterfall or decided rapid. The Severn and the Shannon are much alike in magnitude, but in a distance of 213 miles the latter descends 161 feet, while the former, in 210 miles, descends 465 feet, thus giving to the Shannon an average fall of 9 inches per mile, and to the Severn one of 26½ inches. Yet the Severn has no rapids or falls, while the Shannon, with an average fall of one third less, forms some magnificent rapids, which are the boast of Great Britain. Again, the Tweed and Clyde are of about the same magnitude; the former is 96 miles long, and its total fall is 1,500 feet; and the latter is 98 miles lon g, with 1,400 feet of fall. At one point these two rivers are in the same plain, and less than seven miles apart, yet the Tweed pursues its course to the sea evenly and gently, while the Clyde has not parted with its former companion for a greater distance than 18 miles, before it dashes over falls whose total descent is 230 feet.—*Jameson's Journal, Oct.*

OCCURRENCE OF FRESH WATER ON BEACHES AND SANDY ISLANDS.

MR. E. C. CABOT read a paper, giving an account of some researches he had made, in company with Mr. Desor, to determine the fact of the constant presence of fresh water in dune sand and sand-spits. These researches were conducted at Cape Cod, which they visited in the United States steamer Bibb, under the command of Lieut. Davis, with whose assistance they were made. In every instance where there was a body of sand above the tide-level, with salt water on opposite sides, or entirely surrounding it, *fresh* water was discovered on digging to a moderate depth. On the island of Monomoy, fresh water was found at a depth of two feet. On the beach at the line of high-water, it was obtained almost on the surface. The same fact was observed on Sandy Neck, a long sand-peninsula, which separates Barnstable Bay from Barnstable Harbour. This is particularly remarkable, as good water is very scarce in the town of Barnstable, on the main land directly opposite. In this town is a well, about 150 feet from the shore, in which the water rises and falls with the tide, although only through a space of a foot and a half. As yet Mr. C. had not been able to satisfy himself whether the amount of rise and fall in wells showing this sympathy with tidal fluctuations, depends upon their distance from the salt water or not. Since making these observations, he had noticed that such a rise and fall is not limited to wells in a natural formation. He had observed that, in loose deposits of an artificial character, in the vicinity of salt-water, they also occur, as he had seen in several of the new streets of Boston, where at high tide trenches were found to contain fresh water, but were empty at low tide. An interesting inquiry suggests itself, as to the origin of these *deposits of fresh* water in such loose soil. They cannot be

derived from springs, for these occur distinct from them, in the same formations, and present peculiar characters of their own, often bubbling out from the surface of the sand, even below the line of high-water on beaches. It might be supposed that they are the result, in part, of a filtration of the salt water through the sand. To test this, Mr. Cabot poured a quantity of salt water through sand, and found that it lost two per cent. of its specific gravity; a curious and unexpected result, but not sufficient fully to explain the case. On the whole, he was inclined to accept the opinion of Mr. Mather, that these supplies of fresh water are derived from rains, and are prevented from oozing out laterally, by the pressure of the neighbouring salt water. As this advances, it recedes, and its level rises; as the tide goes out, it follows, and its level is depressed. The practical result from these investigations is, that it will undoubtedly be found that, in all deposits of sand like those examined by Mr. Cabot, an abundant supply of fresh water may be obtained at all times,—a fact of great importance to mariners.

These observations induced some discussion, in the course of which Mr. Ayres said, that he knew an instance of a sand-bank, 8 feet high, formed within his recollection, in which fresh water might be obtained at the depth of eighteen inches. At Sag Harbour there is a well about 40 rods from the tide, in which the water rises and falls 4 feet a little after the tide. A little farther from the shore is another, which rises and falls 2 feet, while another varies 1 foot, and one still farther from the shore is not sensibly affected.

Dr. Pickering mentioned that, in the coral islands of the Pacific, the natives obtain fresh water by a slight excavation. The President said, that in Boston there are some wells situated so high, that it is impossible to account for their water by the supply afforded by rains alone. It would seem, therefore, that it must have been brought by underground currents, perhaps from a great distance, following the course of an impervious underlying stratum.

At a later meeting, Mr. Cabot mentioned some experiments made to ascertain the cause of the non-intermingling of salt water with fresh, in dune sand. Having nearly filled a vessel with salt water, he immersed in it a large sponge saturated with fresh water, containing, imbedded in it, perpendicular tin tubes, with perforated sides. The external pressure caused water to appear in these tubes, and to rise to the level of the surrounding fluid. After standing some hours, the water in these tubes was found to be fresh. On reversing the experiment, placing the sponge full of fresh water first in the vessel, and gradually filling the surrounding space with salt water, the same result followed. Capillary attraction seemed to be the force which kept the different fluids apart. With regard to the difference between fresh water in dune sands and springs, Mr. Cabot said that he did not consider it an essential one. In the former case, the water formed, so to speak, a homogeneous spring; in the latter, underlying strata and lateral boundaries limited it, and gave it the character of a current.—*Proc. Boston Nat. Hist. Society.*

FORMATION OF FRESH-WATER PONDS ON THE COAST.

At one of the meetings of the Boston Natural History Society, Dr. Cabot stated, that, during a recent visit to the east end of Long Island, he had made some interesting observations on the formation of the fresh-water ponds by the closing up of the entrances to inlets from the sea. He mentioned one, which is from four to six miles in circumference, and separated from the sea by a sand-beach about twenty rods wide. Within the memory of those now living it was an open strait, but its waters are now entirely fresh, and contain fresh-water animals and plants. Within twenty years oysters could be obtained here, and their shells are still abundant. In the same vicinity are many other similar ponds, and in many cases the process may now be seen going on. The sea washes up a sand-bar across a bay, and in time stops the entrance. It is an interesting question, how the water in these ponds becomes changed from salt to fresh.

This statement gave rise to some discussion in the course of which it was remarked, that the change in the water might, perhaps, be accounted for by supposing that all the water originally inclosed had percolated through the sandy bottom, and its place had been supplied by rains and neighbouring springs.

ICE-CAVE IN RUSSIA.

In the recent work of Sir R. I. Murchison on the Geology of Russia, he mentions a remarkable ice-cave, situated not far from Orenburg. It is at the base of a hillock of gypsum, at the eastern end of a village connected with the imperial establishment, and is one of a series of apparently natural hollows used by the peasants for cellars or stores. It possesses the remarkable property of being partly filled with ice in the *summer*, and totally destitute thereof in *winter*.

"Standing," says the author, "on the heated ground, and under a broiling sun, I shall never forget my astonishment, when the woman to whom the cavern belonged opened a frail door, and a volume of air so piercingly keen struck the legs and feet, that we were glad to rush into a cold bath in front of us to equalize the effect! We afterwards subjected the whole body to the cooling process by entering the cave, which is on a level with the street. At three or four paces from the door, on which shone the glaring sun, we were surrounded by half-frozen *quass* and the provisions of the natives. The roof of the cavern hung with solid undripping icicles, and the floor might be called a stalagmite of ice and frozen earth. We were glad to escape in a few minutes from this ice-bound prison, so long had our frames been accustomed to a powerful heat." The cold in this cavern is invariably the greatest inside when the air is the hottest outside. As soon as winter sets in the ice disappears, and in mid-winter the peasants assured the travellers that the cave was of so genial a temperature, that they could sleep in it without their sheepskins. At the very period when Sir R. I. Murchison visited it, the thermometer was 90 degrees in the shade; yet a single plank was the division between a burning sun and a freezing

vault! The cave is about 10 paces long, and 10 feet high. It has a vaulted roof, in which great fissures open, which appear to communicate with the body of the hillock. Saussure long ago gave the clue to the real exposition of this paradoxical phenomenon; and Professor Pictet, following it out, has satisfactorily demonstrated that it is a beautiful example of a practical illustration in nature of that first principle in chemistry,—*evaporation produces cold*. It is well known to the geological student, that, in certain mines which have a horizontal gallery terminating in a vertical shaft communicating with the atmosphere, a current of air in *summer* descends the vertical shaft, and emerges from the horizontal; while in winter the current *sets in* at the horizontal, and issues from the vertical shaft. The arrangement of this cave is very similar. Thus the cave is the horizontal, and the vertical shaft lies in the mass of the hill. Suppose, then, the mean temperature of the hill to be about 48 or 50 degrees. The descending summer current passing through the channels in the hill evaporates the water it meets with in its progress, and so rapidly as to become colder in the descent; until, reaching the cave, it is even below 32 degrees, and there freezes the water collected in it. The hotter the air outside, the greater the destruction of equilibrium between the interior and exterior columns, which communicate at their base in the cave; consequently, the more rapid and intense the evaporation, the more severe the measure of cold produced. "This view," says Sir R. I. Murchison, "is supported by reference to the climate of the plains of Orenburg, in which there is a great wetness of the spring caused by melting of the snow, succeeded by an intense and dry Asiatic heat."

THE SNOW-LINE IN THE HIMALAYA.

LIEUT. STRACHEY, of the British army, has made some very extensive observations on the snow-line of the Himalaya. By the term *snow-line* should be understood the lower limit of perpetual snow, that is, the highest limit to which the snow recedes in the course of the year, or the boundary-line of the snow which resists the effect of summer. In describing one portion of his observations he says, "I conclude, then, that 15,500 feet should be assigned as the mean elevation of the snow-line at the southern limit of the belt of perpetual snow in Kumaon, though this will be rather under than above the fact." At the head of the Pindur, near the glacier from which that river issues, he considers that the ground was free from snow *in situ* up to a height of 15,000 or even 16,000 feet in October. With reference to the snow-line in the northern part of the chain of mountains, he thinks that 18,500 feet must be nearly the average height, at least on the Jainti ridge. These observations were mostly confined to that portion of the Himalaya lying between the northwestern frontier of Nipal and the River Sutlej; this is extending from about the 77th to the 81st degree of east longitude, while the breadth from the plains of India on the south to those of Thibet on the north is about 120 miles.—*Jameson's Journal, Oct.*

ON THE MOTION OF THE GLACIER OF THE PINDUR, IN KUMAON.

LIEUT. STRACHEY has communicated to the Asiatic Society of Bengal an account of some observations made by him on the motion of the glacier of the Pindur. He made use of a theodolite, with a telescope and stakes placed on the glacier and on both sides of it. He found that between noon on May 21st and 8 A. M. on May 25th, the stake on the west moraine of the glacier had advanced 1 foot 9½ inches, on the medial moraine 2 feet 9¾ inches, near the middle of the clear ice 3 feet 1 inch, and on the eastern moraine 1 foot 5½ inches. The mean motion of the clear ice in twenty-four hours was 10 inches in the upper part, and 9.4 in the lower. The elevation of the foot of the glacier is 11,929 feet above the level of the sea, and the slope of the surface of the glacier is about 7½ degrees.

THE CHARLESTON ARTESIAN WELL.

IT is known that the Artesian well at Charleston has now reached a depth of 850 feet without finding water. Many despair of a successful result, but Professor Brumley, of South Carolina College, who has taken great interest in the undertaking, thinks that water will soon be reached. It was the impression of Professor Tuomey that the buhrstone sands were water-bearing strata, but in this he seems to have been mistaken, for they have been passed, and cretaceous limestones discovered, which present no obstacle but their thickness, for in all cases, Professor Brumley says, so far as his knowledge extends, a distinct series of thick sands and gravels underlie the cretaceous limestones and marls. These must be passed, therefore, before the prospect of ultimate success can be regarded as hopeless.

It is worthy of remark, that the same obstacle was encountered in Paris. There, too, the tertiary overlie the cretaceous strata,—both series enormously thick, and separated by beds of sand, &c., the equivalent of our buhrstone. These beds of sand were expected to yield abundance of water. In this expectation the projectors of the undertaking were disappointed, and it was, for a time, abandoned. The work was subsequently renewed, the cretaceous limestones were perforated, the sand-beds were reached, and then the water rose, high above the surface, with such violence as to cause at first a serious alarm.

The only real obstacle to be apprehended, therefore, is the thickness of the cretaceous limestones and marls, under the city. On this subject, of course, we have no positive knowledge. The strata at Charleston are concealed from view, and cannot be directly measured. But we can make an approximate estimate, on which an opinion may be safely predicated. The cretaceous limestones, constituting one continuous series from New Jersey to the Mississippi Valley, have been carefully studied by geologists, in many places, either where they rise to the surface, so exposed as to be susceptible of measurement, or where they have been perforated by Artesian wells.

These investigations have shown that they vary in thickness from

100 to 1,000 feet, and that they are thicker and much more extensive in the Western than in the Atlantic States. Yet in Alabama the Artesian wells (not less than 500 in number) rarely exceed 600 feet. True, the strata vary considerably in thickness in different prominent localities. Thus, on two adjacent plantations, one man's well may be only 400, while his neighbour's is 500 feet deep. Still the average thickness is, as has just been stated, pretty accurately known, and does not exceed 600 feet. This induces the belief that, as the auger is known to have penetrated the strata several feet, perhaps fifty or more, the city well can, in no event, exceed 1,500 feet, and that water will probably be obtained at a much less depth.

It will be necessary, however, to tube the well from top to bottom; otherwise the water, passing through such an extent of limestones and marls, impregnated with soluble saline substances, will be very impure.

DRAINING THE MINES OF SIERRA-MORENA.

An English company have leased the celebrated silver mines of Guadalcanal, in Seville, in Spain, which have been under water for a period of 150 years. Before that time they produced to the Spanish government £100,000 per annum, in duties alone; and from the proceeds of these the palace of the Escurial was built. They were the property of the Fuchars, rich contractors; who not satisfied with the enormous wealth they derived from them, secretly took away the ores from a new lobe they discovered, without giving notice to the government, and, to prevent imprisonment and confiscation, they let the water into the mines,—and for 150 years they have remained in the state in which they were thus left by them. About six months ago, however, the mines were purchased by an English company on the most advantageous terms, and the draining of them has already been commenced. The depth of the mines is about 120 fathoms. The work is under the superintendence of Mr. Harvey, the chief engineer employed in draining the Haarlem Lake in Holland.—*London Athenæum.*

CONNECTICUT COPPER MINES.

These mines, which are situated near Bristol, have been known for some time, but they have of late excited much interest among capitalists and scientific men, and there are now over 300 men at work in them. Prof. Silliman is of the opinion that they extend over thirty miles south of Bristol, and that if thoroughly worked they would give employment to 30,000 miners, while many others consider that they can be made the most profitable mines in the United States.—*Farmer and Mechanic.*

Another extensive copper mine has just been opened at Litchfield, South Farms. Prof. Hubbard of Yale College has examined the mine and made a highly favorable report of its value and location. We understand that the developments thus far made show this mine

to be far superior to that at Bristol, which last year paid a net profit of $120,000, and is growing better and richer every foot that it increases in depth.—*Bridgeport Farmer, Jan.* 8, 1850.

DISCOVERY OF METALLIFEROUS DEPOSITS.

M. Burat, in a paper in the *Annales des Mines*, "On the Continuity of Metalliferous Deposits in Depth," observes:—The only prominent facts which may be cited as discoveries of the nineteenth century, are,—1st. The washings of the auriferous sands of the Ural, which have increased to an annual produce of more than 10,000 kilograms* of gold; 2d. The copper mines wrought in the island of Cuba, in the neighbourhood of Santiago, which were opened in 1833, on the old works, and now send 40,000 tons of the mineral to Swansea; 3d. The calamine mines of Belgium and Rhenish Prussia, which, from a produce scarcely worth naming, now yield 12,000,000 kilograms of zinc; 4th. The lead mines of Missouri and Illinois, the importance of which is not yet appreciated, but which, it is said, would produce 30,000,000 kilograms of lead; 5th. The copper mines of Lake Superior, the working of which is projected on a large scale. To these, says Prof. Jameson, we may add the very productive mines of red copper ore, and green and blue malachite, of Bura-Bura, in Australia. And, also, the gold washings on the Sacramento River, in Alta California.

DISTRIBUTION OF GOLD ORE OVER THE SURFACE OF THE GLOBE.

At the late meeting of the British Association, Sir R. I. Murchison drew attention to the distribution of gold over the surface of the globe, and to a comparison between the auriferous deposits of the Ural Mountains and California. As the result of observations among the Ural Mountains, he had formed the opinion that gold veins had generally been produced wherever certain rocks of intrusive character—namely, greenstones, porphyries, sienites, granites, and serpentines—had been intruded through paleozoic rocks. It was, in short, among clay-slates, limestones, and grauwacke-sandstones which had been penetrated by such igneous rocks, that quartz veins abounded, and with them a diffusion of gold ore in veins, leaf, and grains. To the general view of Baron Humboldt, that the richest gold deposits were those which were derived from ridges having a meridian direction, several geologists were decidedly opposed; but Sir Roderick was of opinion, that although they might not be able to explain the cause, it was a fact that the greatest quantity of gold ore had been obtained from chains having a nearer relation to north and south than to the equatorial, or east and west directions. This, however, might be due to the general form of the chief masses of land, and to the prevailing strike of the paleozoic rocks. Humboldt, in view of the great lumps occasionally found in the surface rubbish, had supposed that there

* A kilogram equals 2lb. 3oz. Avoirdupois.

might have been some connection between the production of gold and the atmosphere, since, judging from these specimens, it is from the superficial extremities of quartz veins that the richest branches of gold have been derived, while vein-stones followed downward have usually proved unproductive. Notwithstanding, there are cases, chiefly on a small scale, as in the Hungarian mines, where gold ore continues to ramify in vein stones to great depths; yet it is a statistical fact, that all the great masses of gold have been derived from superficial detritus. This detritus should not be confounded with modern alluvial deposits.

Mr. Murchison then entered upon a comparison between the gold regions of the Ural and those of California, and showed, by means of maps and sections of the former, and from the descriptions of the latter country, that there was a great coincidence in their mineralogical structure, and that with these "constants" the same results obtained in America as in the Ural. He contended, however, against the inference, that any large tract of California would be found to be as uniformly auriferous as the banks and slopes of the upper tributaries of the Sacramento. The breadth of the auriferous detritus of California had yet to be ascertained. As, however, the lower or coast ridge, which passed by San Francisco, seemed to be in miniature what the higher parallel mountains were upon a larger scale, in being composed of greenstones, porphyries, grauwacke, sandstones, and quartz rocks, it was probable that very much of the great intervening valley of the Sacramento might be strewed over at intervals with auriferous *débris.*

In regard to views advanced by Sir R. I. Murchison, the President of the Association stated, that he thought that, as geologists, they should receive with caution the opinion that gold was more abundant on the surface than at great depths; neither should they take it for granted, that the gold-bearing mountains had a bearing from north to south rather than from east to west,—as in California, for example, they differed somewhat from the position laid down, and the Pyrenees differed completely.

Prof. W. Rogers stated, that in Georgia and the Carolinas the gold was uniformly imbedded in, or associated with, quartz rock, forming veins in the talcose and micaceous schists and altered sandstones. He had invariably, in all his researches, found that gold was generally obtained by washing the alluvium in the beds or along the banks of rivers. But these superficial deposits are generally very rapidly exhausted from the wasteful mode of conducting the works. It is probable that the difficulty of obtaining gold by mining is universal and continued at all depths; it is in part owing to the association of the gold in solid rocks with iron pyrites, ores of copper, and lead, so blended as to cause great trouble and expense in separating them; near the surface of the rocks this process seems to have been accomplished by atmospheric agency, for it is impossible to suppose that gold was originally most pure and abundant over what is now the surface. The general trend of the old metamorphic rocks in the United States is northeast by southwest, and the gold veins conform to this

general direction. Gold has been found at intervals from Canada to Georgia, a distance of 1,000 miles, and although insignificant in quantity, as compared with California, it occurs under the same conditions. Prof. R. was of the opinion that the amount of gold obtained in California will greatly decline after a few years. Prof. Sedgwick contended that the *age* of the rock was not a *constant* phenomenon in connection with gold, but that the *condition* of the rocks did appear to be constant. Prof. S. disputed Humboldt's generalization upon the direction of the auriferous chains, which he said was no more north and south in most cases than mountain chains run mostly north and south. Sir H. de la Beche thought that gold was not found as had been stated by Sir R. I. Murchison in the older paleozoic rocks only, but that it depended more on mineral and physical conditions than on the age.

Sir R. I. Murchison then replied, showing that the theories of those who differed from him with regard to the greater abundance of gold at the surface than in the veins, differed from every practical man on the subject; they differed also in regard to the fact, that the hill ranges were from north to south more than to the equatorial line. This was so in all cases in which large quantities of gold were found, although some modification might be necessary as related to small quantities.—*London Athenæum, Sept.* 22.

ANALYSIS OF CALIFORNIA GOLD.

The following interesting account of an analysis of the golden spangles or sands of California was read by M. Dufrenoy before the Paris Academy of Sciences. The spangles of gold of California are much larger than those which come from the washings of the Ural or those of Brazil. They also differ in their reddish color, which causes them to be distinguished readily at first sight. According to an accurate analysis, their composition is,

Gold,	90.70
Silver,	8.80
Iron,	0.38
Total,	99.88

The soils of the Sacramento valley are light; to the touch they appear soft enough, but on rubbing, a few particles of a hard substance are felt. Their color is light brown; the microscope shows them to be almost entirely silicious; the little fragments of which they are composed are angular and transparent; easily conglomerated together; resemble in their color and transparency a saline mass; nothing but distinct grains are distinguished by the naked eye. A piece of gold sent to "L'Ecole des Mines," weighing 47.9414 grams (nearly 1¾ oz.), is of a somewhat red color, its composition otherwise analogous to that of the spangles. This piece of gold adheres to some white quartz, the surface of which is worn like a pebble; nevertheless it preserves its original form, which is that of a thick vein, flat and irregular. The form of this piece, and the presence of the quartz, re-

veals the fact, that, in the primitive beds, gold forms small veins, with a quartzose gangue.

The schistose fragments which exist in the valley of the Sacramento give reason to think that the mountains which contain auriferous veins consist rather of micaceous schist than of granite properly so called. This conclusion agrees with the examination of washed auriferous sands.

The general tint of the auriferous sands is black. We perceive at first sight that the oxidulous iron predominates, and that it is that mineral which causes the color. The analysis was therefore commenced by separating this by means of the magnet; 3 grams gave 1.79, or 59.82 per cent. Notwithstanding the separation of this large quantity of oxidulous iron, the sands still retained their dark color; they were very rich in gold, and numerous spangles were more distinctly remarked. Examined by the microscope, the sands remaining, after separation of the iron, contained some octahedrous crystals, some with mirror-like facets and but little altered, others rounded, but still brilliant. These crystals, by their form and the color of their dust, appear to belong to titaniferous oxide of iron, and are mixed with flattened crystals, whose hexahedrous projection and red dust cause them to be considered as oligist iron. Lastly, among the black grains were observed dull, irregular, and soft fragments, which have all the character of manganese. Mixed with the titaniferous oxidulous iron, in the second portion of the sands, were many crystals of white zircon, terminal at their two extremities. These crystals are for the most part short. Their perfect transparency and absence of color cause them at first to be taken for quartz, but where their facets are counted, there can be no longer doubt that they belong to a prism having a square base. Notwithstanding the smallness of these crystals, their perfection is such, that the incidence of many of their faces can be measured.

GOLD DUST FROM CALIFORNIA.

From nearly all the deposits of gold which exist in various parts of the world, the metal is obtained in part in the form of dust, or minute grains disseminated through the sand, almost invisible to the eye. As yet no returns of gold in this state have been received from California. For the purpose of determining whether it really existed and had been overlooked, a careful examination of several portions of the black metallic residue left after washing in California has been made by Dr. Hayes of Boston. The result shows that gold dust in large quantities exists mingled with the ferruginous and chromiferous sands, which heretofore have been thrown away as worthless. Dr Hayes estimates the amount of gold in one ton of sand to be at least $1200.

GOLD IN MARYLAND.

A few months since, gold was discovered on the farm of Samuel *Elliott, in* Montgomery County, Md. From the specimens already

obtained, the locality appears to be valuable. One piece yielded, when analyzed at the mint, at the rate of 744 grains per cwt. of ore, or $610 per ton; a second specimen yielded 960 grains or $787.20 per ton, and a third 206 grains or $168.80 per ton. The whole give an average of 636 grains per cwt. of ore, or $522 per ton. The quartz, which forms the matrix of the gold, crops out amidst a decomposed talcose slate, so that quarrying is very easy. Ores of copper and iron are also present.—*Proc. Amer. Phil. Soc.*, 1849.

GOLD DISCOVERIES IN AFRICA

If the St. Petersburgh papers may be trusted, it is not the Western Continent alone that is to write on the immediate time its distinctive name,—the Age of Gold. According to them, Col. Kavelovski, director of the mines of Siberia, at present engaged in a mineralogical exploration of the interior of Africa, has found on the right bank of the Somat, a day's journey from Cassen, several large hills of auriferous sand. The washing of these sands yields much more gold than does that of the Siberian sands. Stimulated by this discovery, the Colonel extended his examination; and on the banks of the Ramla, the Goucka, and several other rivers, he found traces of auriferous sand. The Colonel was about, it is added, to transport miners and gold-washers from Russia to experiment in the field of his discovery on a large scale.—*London Athenæum.*

THE GOLD MINES OF SIBERIA.

The discovery of the California gold mines has given rise to many notices of the gold regions of the world, but we have seen none more interesting than the following account of the Siberian mines, which have hitherto been by far the most productive of any known. "The mines of Siberia, from their number and richness, are one of its most distinguishing features. They yield gold, silver, copper, tin, lead, zinc, and quicksilver, and an inexhaustible abundance of that most useful metal, iron. The iron mines are in the far east, that is, the nearest approaching our far west; they are at Nertchinsk, on the head waters of the Amour, a noble river emptying into the Pacific by a mouth nine miles wide, and, for a large part of its course, full fifteen hundred miles, navigable by steamboats. Our accounts of the Siberian gold mines are fragmentary, still enough is known to show their high importance. In 1847, the produce was $25,000,000. In 1848, it was a fraction short of $20,000,000. These mines are wrought by private enterprise, and a single family, the Demidoff, is said to have long received every year the enormous sum of $2,000,000, in gold and other metals. In Siberia, the same as in California, every one is allowed to dig, except on private lands, and the very poorest often become the richest. There is a lump of gold in one of the cabinets of St. Petersburg weighing 78 pounds, the largest in the world, worth, at $16 the ounce, full $15,000. The government receives fifteen per cent. for transporting the metal, coining it, and delivering the coin. At

the date of March 31, 1847, the gold bullion, entirely unproductive, in the imperial treasury amounted to $85,000,000. By an order then issued, $22,500,000 was invested in public stocks,—mostly French and English. And again in May, 1848, there was lying idly in the vault $82,000,000.

"The great extent of the Siberian placers is worthy of special study as regards their bearings on the history of the future. They are larger than those of California, even according to our widest calculations. To exhibit the estimate formed of them by those competent to judge, we refer to the recent work of Sir George Simpson, Governor of the Hudson's Bay Territories in North America, and also to that of Sir R. I. Murchison, President of the Geological Society of England. Both of these most intelligent persons have visited Siberia. Sir George says:—'The whole surface of the country, from the Uralean Mountains to the Yablonnoi chain, would appear to be one vast bed of the precious metals. The government reserves to itself all the mines, turning them to excellent account, both as sources of revenue and penal colonies. The washeries, however, are open to private enterprise. When capitalists wish to embark in the work, they employ peasants of experience, and there are instances in which peasants have earned $40 a day during the two or three months of the working season. As an instance of the speculative character of this occupation (i. e. the mines), one individual, who embarked in the business about three years ago, obtained no returns at all till this season, when he was richly repaid for his outlay of more than a million of dollars, by obtaining gold to the amount of $4,200,000. The precious metals are more abundant in Siberia than in all the rest of the Old World, the most precious of them being, perhaps, more plentiful than in all the rest of both hemispheres taken together.

"'At present the mines and washeries are very unfavorable to the settlement and cultivation of the country, by calling away laborers from more steady occupations to the pursuit of precious metals. Already has the effect been seriously felt in Kra-noyarsk, where a pood of meat has risen in ten years from $1.35 to $15, and where fowls have risen from 20 cents apiece to $1.20.'

"Sir R. I. Murchison, knighted for his geological researches, says:—'It is a fact, that within the last four years only, a tenth portion of the earth's surface, Chinese Tartary and Siberia, has been for the first time made known to us as in many parts auriferous; and when from one portion of it only Europe is already supplied with so large an amount of her chief circulating medium, well may political economists beg for knowledge at the hand of the physical geographer and geologist, and learn from them the secret on which the public faith of empires may depend.'

"These Siberian gold regions, the description of which reminds us of the daily accounts from California, began to be discovered some twenty years ago quite extensively,—though during the last ten years only has their vast value been fully revealed."

The Ecole des Mines, at St. Petersburg, possesses a series of over 750 pieces of the Siberian gold, among which is one, discovered in 1848, *weighing* 90 pounds, which is in very nearly a pure state.—Editors.

QUICKSILVER IN CALIFORNIA.

'HE deposit of quicksilver, known to exist in California, is a sulphu-f mercury, or native cinnabar. The stratum of mineral, several feet ckness, has been traced for a considerable distance along its line of . The specimens assayed at the mint range from 15.5 to 33.35 per of metal; it is easy of access, and is mined and reduced without ılty. So much of the mine as has been traced is situated on a to which the title is properly valid; and, since the United States possession of the country, an attempt has been made to acquire to the *mine* by *denouncement*. This proceeding is invalid. It fore remains for Congress to determine whether they will relinquish sert the title of the United States in this mine."—*Report of the Sec-y of the Interior.*

e extract the following additional notice of the quicksilver deposits lifornia from a letter, published in the *Merchants' Magazine*. by 'euchtwanger. "The mercury mines of Upper California, next to old diggings, promise to be of great importance to the emigrant to country; rocks and mountains, to the height of several thousand have already been found to consist of nothing but cinnabar, and more will undoubtedly be developed by the pursuit of the ralogists and geologists flocking there. It is well known that peration of distilling the metallic mercury from the cinnabar does require much skill, and but very simple apparatus; they are the , nearly, as were used eighteen hundred years ago. To extract a iderable quantity at very little expense, with a common lime-kiln or -furnace, properly constructed, large quantities of the mercurial intermixed with slacked lime or blacksmith's iron scales, may be ned, or exposed to a red heat for twenty-four hours, proper precau- being used to prevent the rising mercurial vapors from escaping ıgh any other place than the orifices constructed in the chimneys, so it may be precipitated therein in the cold water running through e reservoir at their bottoms, whereby not less than 2,000 pounds be manufactured daily. If we consider the inexhaustible supply e material, and the high specific gravity of cinnabar, which is eight s heavier than water, we can form some idea what a quantity of ksilver may be produced out of a hill of 1,000 square feet. Admit-100 pounds of cinnabar to consist of 86 of mercury and 14 of sul-, nearly half a million pounds of pure quicksilver may be extracted of such a single mountain. How many pounds of pure quicksilver be produced from a whole range of such mountains, when their els contain nothing but cinnabar? It is obvious that California will ble to produce more quicksilver than the home consumption will ant, and it will necessarily be wrought into other useful applications, as vermilion, which has hitherto been imported from China, and ral European cities, as Cadiz, Idria, &c. Four thousand quintals nnually exported from the latter city, and nearly ten thousand quin-from China."

PLATINUM AND DIAMONDS IN CALIFORNIA.

THE existence of platinum in the gold sands of California has of late been often announced. Specimens from the region have recently been seen by the editors of this Journal. We also learn from a reliable source that the diamond occurs at the placers. Rev. Mr. Lyman, formerly of New England, describes a crystal seen by him, of a straw-yellow color, having the usual convex faces, and about the size of a small pea. He saw the crystal but for a few moments, and had no opportunity for close examination; but the appearance and form left little doubt that it was a true diamond.—*Silliman's Journal.*

NATIVE COPPER OF LAKE SUPERIOR.

THE size of some of the masses of native copper found in the mines of Lake Superior almost exceeds belief. At the Cliff mine they have been broken up of 60 and even 80 tons in weight. Such pieces are reduced in the mine to fragments of 7 tons or less, and after being hoisted to the surface are still further reduced. The most extraordinary mass yet met with has been found at the Minesota mine during the past year. Two shafts have been sunk on the line of the vein, 150 feet apart. At the depth of about 30 feet they struck massive copper, which lay in a huge sheet, with the same underlay as that of the vein, —about 55° towards the north. Leaving this sheet as a hanging wall, a level was run under it connecting the two shafts. For this whole distance of 150 feet the mass appears to be continuous, and how much farther it goes on the line of the vein either way there is no evidence, nor beside to what depth it penetrates in the solid vein. It formed the whole hanging wall of the level, showing a width of at least eight feet above the floor where its lower edge was lost. In one place, where a partial break afforded a convenient opportunity, it has been cut through, and its thickness found to exceed 5 feet. Assuming the thickness to average only 1 foot, there would be in this mass 1,200 cubic feet, or about 250 tons.

The mode adopted to remove these masses is to cut channels through them with cold-chisels, after they are shattered by large sand-blasts put in behind them. Grooves are cut with the chisels across their smallest places, one man holding, and another striking, as in drilling. A chip of copper three fourths of an inch wide, and up to six inches in length, is taken out, and the process is repeated until the groove passes through the mass. The expense of this work is from $8 to $12 per superficial foot of the face exposed. Fragments of vein-stone inclosed in the copper prevent the use of saws. A powerful machine, occupying little room, is much needed, which would perform more economically this work. The greatest thickness of any mass cut through at the Cliff mine has been about 3 feet. Their occurrence through the vein is not regular. Barren spots alternate with productive portions. The same is the case in all the mines. *The total* product of the Cliff mine for the year 1848 is estimated at *830 tons,* averaging 60 per cent. The product of the year 1849, it is

thought, will exceed 1,000 tons. The whole amount of copper annually imported into the United States is about the value of $2,000,000, or about 5,400 tons. But little has been supplied from our own mines. Nine such mines, then, as the Cliff would render us independent of foreign supplies. Present appearances indicate that this amount of copper must be supplied in a very few years, and this metal soon become, as lead already has, one of export instead of import. The recent failures of mining speculations, wildly undertaken, and ignorantly and extravagantly conducted, may for a time check the development of these mines; but their wonderfully rich character is now beginning to be properly appreciated, as well as the reliance which may be put in the surface-appearance of the veins.

The silver found associated with the copper has not proved of much importance, perhaps for the reason that the greater part of it is purloined by the miners. The Cliff mine has probably yielded more than $30,000 worth, of which not more than a tenth part has been secured by the proprietors.—*Proc. of the American Association.*

LAKE SUPERIOR COPPER MINES.

A CORRESPONDENT of the *Railroad Journal,* writing from Mackinaw, November 2d, gives the results of the season's operations in the Lake Superior copper mines, as he obtained them from the directors or agents. The Cliff mine seems to have been by far the most productive, the company having shipped, or had ready to ship, 1,000 tons on November 1st, the average percentage of which is estimated at 63. Six other companies mentioned vary in their products from 57 to 6 tons; the percentage of four is 67; of one, 75; and of the one which produces only 6 tons, 100. Four of these mines, it is estimated, will, during the year 1850, produce in the aggregate 1,950 tons. A large number of new companies are being formed, but during the next year they can do little more than clear away for future operations.

BLACK OXIDE OF COPPER FROM LAKE SUPERIOR.

AT a meeting of the Boston Natural History Society, Jan. 3d, Mr. J. D. Whitney made some remarks on the remarkable vein of black oxide of copper which was formerly worked at Copper Harbour, Lake Superior. The ore in the vein was 14 inches wide, and for a short time the mine furnished a good supply of copper ore, yielding about 60 or 70 per cent. of metallic copper. It was soon exhausted, a bed of fine-grained sandstone cutting off the copper vein, the calc spar only continuing in the sandstone below. It was the only vein of this substance, and perhaps the only locality known in the world, and specimens will be highly prized by the mineralogist hereafter. The substance called copper-black, and sometimes black oxide of copper, which occurs in an earthy, pulverulent form, is not to be confounded with the pure oxide of copper found at Copper Harbour. Copper-black is a mixture of various hydrated oxides, especially of iron, man-

ganese, and copper, and is evidently the result of their decomposition. The oxide of copper found at Copper Harbour is generally compact, though the purer specimens have a crystalline structure. Some specimens are almost chemically pure, though it is generally mixed with a little silicate of copper. One of the purest specimens contained only 1.2 per cent. of impurities, mostly silica, with traces of lime and iron. As the oxide of copper of this remarkable vein has not been mineralogically described, the following description is added. Crystallized in cubes, with their solid angles occasionally replaced; generally however, massive, with crystalline structure, sometimes earthy; no traces of cleavage; $H = 3$; $G = 6.25$; color, steel-gray to black; lustre metallic, the earthy varieties acquire a metallic lustre on being scratched or cut with a knife; opaque. Chemical composition CuO almost pure; containing copper 79.86, oxygen 20.13.—*Proc. Bost. Soc. Nat. Hist.*

Among the masses of black oxide of copper brought from the mine at Copper Harbour, Mr. J. E. Teschemacher discovered regular cubic crystals of the ore, crystals which show that the ore is not a mere mechanical mixture of copper smut with earthy matters for a cement, as some have supposed. There are also found at the Copper Harbour mine, chrysocolla, or hydrous green silicate of copper, and the black silicate, which contains a less proportion of water. These ores, we can easily conceive, might be produced by the decomposition of a solution of copper by the action of a hot solution of lime. The black oxide may have been derived either from a solution, or from igneous sublimation. We know that black oxide of copper is sublimed from the crater of Vesuvius, and is deposited in fine splendent scales, like specular iron ore in the lavas.—*Proc. American Association.*

ON THE EXISTENCE OF VANADIUM IN THE COPPER ORES OF LAKE SUPERIOR.

During the course of the past year, Mr. J. E. Teschemacher, of Boston, having noticed the presence of a dark-colored mineral among some ores of copper brought from Lake Superior, submitted the same to a chemical analysis. The result showed the presence of vanadic acid in considerable quantity. A discovery so unlooked for caused a suspicion of error, and the substance in question was submitted to a distinguished chemist for further examination and analysis. The result coincided with that obtained by Mr. Teschemacher, and proved beyond all doubt that vanadium exists in some of the ores of copper found near Lake Superior. The manner in which it is disseminated through the specimens analyzed affords a strong presumption that it will be found hereafter in considerable quantities. Vanadium was discovered in 1830 by Sefstrom, in iron prepared from the iron ore of Taberg, in Sweden. Soon after Sefstrom's discovery, the same metal was found by Johnson of Enland in combination with lead, and forming a vanadiate of lead. A similar mineral was found at Zimapan, Mexico, in 1801, by Prof. del Rio. He supposed it to be a new metal, and applied the name erythronium, from the red color of its acid;

but as Descotils, on being appealed to, declared the mineral to be a chromate of lead, Del Rio abandoned his own opinion in deference to a higher authority. Thus have three persons noticed the existence of vanadium, without the knowledge of each other's labors; but the merit of being the first discoverer is fairly due to Sefstrom.—*Editors.*

ON THE DEPOSITS OF IRON NEAR LAKE SUPERIOR.

According to Mr. Whitney, U. S. Geologist, the deposits of iron ore in the regions bordering on Lake Superior are immense. It exists mostly in the form of fine-grained, almost chemically pure peroxide, and occupies about 80 quarter-sections of the mineral country. At the nearest point it is about 12 miles from the Lake. The quantity of the ore is beyond all calculation, and the iron made from it is equal to the best Swedish. It appears in the form of hills, ridges, and knobs, evidently of igneous origin, the highest points being 1100 feet above the level of the lake. In some cases the hills or ridges are more than half a mile in extent. The cost of iron manufactured from this ore is from 24 to 30 dollars per ton, while the price of Swedish is about 90 dollars. The forests in the vicinity of the ore-beds afford abundant materials for the production of charcoal, to be used in smelting.

ARGENTIFEROUS GALENA.

Large bodies of this valuable mineral are found in Arkansas. Silver mines also exist in that State, some of which were worked by the Spaniards prior to the year 1800. Gold mines appear recently to have been found, and iron to an endless extent. The present workings of argentiferous galena are on the estates of the "Southwestern and Arkansas Mining Company," situate about ten miles from Little Rock. The ore is said to be exceedingly rich. The highest assays have exhibited as much as 140 pounds of silver to the ton of ore. The lowest assays are about 33oz. The average of silver to a ton of ore is supposed to be about 120oz.,—a presumption founded on the price offered for the ore in England. The importance of even the lowest assay (33oz.) can be estimated from the fact, that, in England, it is considered worth separating for 3oz.

ZINC MINES OF NEW JERSEY.

The Sussex Zinc and Copper Mining Company are now engaged in active mining operations in the town of Monroe, Sussex County, New Jersey. The mines owned by this company are among the most valuable and productive in this country, and are the only ones in the world where the red oxide of zinc is procured in quantity for practical purposes. The locality has been known for many years. It was opened by Lord Stirling who first worked the iron mines in Orange County, and constructed the first furnace there. He worked it proba-

bly for the copper it contained, so long ago that now there are forest-trees a foot in diameter growing on the *débris* thrown out then. As zinc was an article not much known at that time, and not in demand, the copper must have been the object. About 10 years ago the United States government, under advice, worked these mines to obtain zinc to use in the composition of brass for the construction of the standard weights and measures of the country. The zinc was known to be of such excellent quality, that it was procured without regard to expense for the purposes above mentioned. The ore found in New Jersey comes under the fourth species of Thompson, who calls it "Manganesian Oxide of Zinc," but it has lately been injudiciously proposed to give it a new name after Lord Stirling, who was the original patentee of the district of land where it is found. It was first noticed and analyzed by Dr. Bruce, who found it to contain zinc 76, oxygen 16, and oxides of manganese and iron 8; but according to Berthier it has oxide of zinc 88, and sesquioxide of manganese 12. Some recent examinations have, as it is said, detected cadmium in this ore. The mineral crops out at the summit of a ridge that is precipitous on either side, and about three eighths of a mile in length. The removal of a very slight covering of extraneous material lays open the ores. With this red oxide of zinc is found the mineral called franklinite, mingling chemically and mechanically. This franklinite is a species of iron ore which, as found here, yields iron of the finest quality, and fully equal in tenacity and fineness to the Swedish, from which the English manufacture their best steel. It is in veins of from eight to twenty-five feet wide, and lies between two veins of primary limestone, the average depth of which is reckoned by geologists about 2,000 feet. Taking the average of the ore, the zinc and iron are nearly equal in quantity. In some veins the zinc predominates, and in other veins the iron.

One difficulty, which stood in the way of the reduction of zinc ore, has been overcome by the skill and perseverance of the present owners of this Sussex mine; who, instead of separating the zinc from the iron with which it is combined, by calcination, have recourse to roasting, pounding, and sifting, which has the desired effect: the zinc being reduced by the two former operations to a red powder, and the iron being left in coarser imperfect crystals.

The zinc, when in this state, is capable of being reduced to an impalpable powder, and of being used as a paint for fences and out-houses, for which, by its durability and cheapness, it is well calculated. But if it is required to produce the white oxide, it can be readily obtained by calcination, and in this state it promises to supersede the use of white lead as a pigment. But the beauty of the metal alloyed with a very small proportion of tin and lead, is its greatest characteristic. Dish-covers, forks, spoons, &c., made of this metal, are second in beauty to nothing but silver, and in this state it retains its lustre in an astonishing manner. A piece of the rolled zinc has been exposed to the action of the atmosphere for several months without being tarnished in the least degree. The metal also exhibits great ductility and tenacity, and is capable of being drawn to the finest wire and

rolled to the thinnest plates. It has been suggested that this zinc would be better for pipes for conducting water than the leaden ones now in use, as a poisonous corrosive substance is never formed on their interior, as in lead.

MINERAL WEALTH OF JAPAN.

The empire of Japan contains inexhaustible mines of the precious metals; the quantity of gold, silver, and copper exported from Japan, between 1611 and 1706, according to an official report of a Japanese minister of state, amounted to $413,036,800. Gold is so plentiful in the great island of Niphon, that it is thought advisable to regulate the working of the mines by law, lest too great a quantity should be brought into circulation. The currency of the country is composed of gold, silver, and copper.—*National Intelligencer.*

RESOURCES OF RUSSIA.

The metallic produce of the Russian Empire in 1848 was, according to the official returns, as follows, viz.:—1,826 poods of gold, ¼ pood of platinum, 1,192 poods of silver, 254,569 poods of copper, and 8,513,673 poods of wrought-iron. The pood is equivalent to a little more than 36lbs. avoirdupois. The gold from Russia, therefore, represents a value of £3,944,832 (or about $19,720,000), making due allowances for the English alloy.

EMERY FORMATION IN ASIA MINOR.

In a communication to *Silliman's Journal*, for March, Dr. J. Laurence Smith, mineralogist in the service of the Porte, announces the discovery of Emery formations in three distinct places in Asia Minor; one near Ephesus, another near Kula, and a third to the north of Smyrna. The mineral somewhat resembles the protoxides, the silicates, and the anhydrous oxides of iron, generally with an irregular fracture. A monopoly of the emery has been disposed of by the Turkish government for the sum of fifty-five thousand dollars per annum, and eight hundred tons have already been shipped to England. Dr. Smith has also discovered, associated with the emery, oxide of zirconium, and a new micaceous mineral, which he has denominated *emerylite*, having for its composition, silex 30, alumina 50, zirconia 4, lime 13, oxide of iron, manganese, and potash 3.

CHROME AND MEERSCHAUM OF ASIA MINOR.

Chrome and meerschaum have been recently discovered in Asia Minor by Dr. J. Laurence Smith, about fifty miles south of Broosa. In relation to this discovery, Dr. Smith remarks:—"It is a circumstance worthy of notice, that chromate of iron (the first that has been discovered in Asia Minor) is here found in serpentine, as elsewhere. This important fact can explain, to a certain extent, the for-

mation of this chromate. It is well known that serpentine contains all the elements of chromate of iron, which, during the consolidation of this rock, might separate themselves by the force of segregation, so well known to operate in many geological phenomena. Two facts, which seem to confirm this supposition, are, first, the existence of the chromate of iron in masses and not in veins, and secondly, the pale color of the serpentine associated with the chromate. One small specimen, which I have, consists of white rock, principally composed of carbonate of magnesia, in which chromate of iron in small specks is visible. It is possible that this carbonate is the result of the decomposition of the serpentine at the surface, by the action of water containing carbonic acid. The chromate of iron occurs, however, abundantly, and is disseminated in the rocks over a considerable extent of territory.

"In quitting the locality of the chrome, and going northeast, I traversed in several places the serpentine containing veins of carbonate of magnesia, quite pure; and this occurs until we arrive at the plains of Eskihi-sher. It is from different parts of this plain that the meerschaum, most esteemed in the arts, comes. The plain is a deposit of drift, being a valley filled up with the *débris* of the neighboring mountains, consolidated by lime containing no fossils. The meerschaum is found in this drift in masses more or less rounded, the other pebbles being fragments of hornblende and magnesian rocks. I have examined with care the neighboring mountains, which surround the plain, and have found that the rocks are of the same nature as the pebbles in the plain, except those of the meerschaum; but, on the other hand, I found carbonate of magnesia in the mountains, which is not to be found in the plains. And this makes me suppose that the meerschaum owes its origin to the carbonate of magnesia in the mountains, decomposed after its separation by water containing silica. In confirmation of this supposition, the meerschaum, which has not been completely changed, has been found to contain carbonate of magnesia. Another proof that the meerschaum owes its origin to the carbonate of magnesia is, that serpentine, similar to that found in contact with the carbonate of magnesia in the mountains, often adheres to the meerschaum of the plain."—*Silliman's Journal*, *March.*

COAL FORMATIONS ON THE PACIFIC.

MR. WILLIAM RIDLEY, of New York, in a report on the Isthmus of Panama, states that he has recently discovered near Costa Rica, on the Pacific, a "deposit of bituminous coal of such excellent quality, and in such abundance, as to realise every expectation. The coal, as proved on the spot, although taken from an upper seam and exposed for centuries to the action of sea-water, is highly bituminous, igniting freely in the flame of a candle, emitting a fierce flame, and leaving little residuum. In this respect it is fully equal to the upper seams of the best Newcastle or Scotch coals, which are generally considered superior for generating steam.

"Of the quantity which can be procured, no doubt can be entertained that it is sufficient to supply the steamers on the Pacific for ages, since indications and features of a coal deposit have been traced for miles in extent."

The harbour of Costa Rica is easy of access to the largest vessels, and affords peculiar advantages for the shipment of the coal and other productions. Native copper, and copper ore of great variety and richness, have also been found in this vicinity.

At Vancouver's Island the coal is worked so near the surface that a British steam-sloop was lately supplied with sixty-two tons by the natives within three days. Specimens of this coal have been examined for the English Board of Admiralty, and although it yields a considerable percentage of ash, it is not much inferior to the coal of South Wales. In addition to this, the coal-fields of Chili are found to produce a fuel in many respects equal to the coal of Newcastle. These discoveries of coal, and the more recent one at Port Famine, insure the success of steam navigation on the Pacific Ocean.

DISCOVERY OF COAL IN EGYPT.

The *Journal des Débats* publishes a letter from Cairo, of the date of Aug. 1st, which announces the discovery by a French civil engineer of a stratum of coal in the vicinity of the Nile, towards Upper Egypt. This discovery will relieve the government of the tribute paid to England for the purchase of this indispensable article. Two engineers, an Englishman and a Frenchman, were employed about three years ago to examine the country in the vicinity of the Nile, to see if any coal existed there. They reported that none did exist, and that further search would be useless. But now it appears that they were mistaken.

THE CUMBERLAND COAL.

The Cumberland coal-basin lies in the trough, or valley, formed by the two ridges into which the Alleghany range forks as it advances in a northeasterly direction towards Northern Virginia, and, crossing the western part of Maryland, enters Pennsylvania. The valley is about thirty-five miles long and ten wide. Its southern half is *drained* by the north branch of the Potomac, which, after flowing half way up the valley, and receiving the waters of numerous streams, the chief of which are Abram's Creek, Spring River, and Deep Run, in Virginia, and Three Fork River, Savage River, and George's Creek, in Maryland, suddenly turns to the southeast and cuts a way for itself out of the valley, (and, as we may add, cuts a natural canal for the miner *into* the valley,) through the east ridge of the range. A similar natural channel and passage is afforded by the Savage, which, in like manner, makes its way through a pass in the West, or Back-bone ridge, cutting through the mountains, as it

were, to their roots, in a manner which the piety of the capitalist is tempted to recognize as quite providential.

The country between the ridges is a succession of hills and ravines. At the bottom of the ravines flow the streams, some of which we have mentioned, and which, flowing into the Potomac, drain the whole region. Cropping out on the sides of these hills, and in successive layers, from the bottom to the top, are found beds of coal, iron-ore, sandstone, and limestone. The coal-beds are from two to seventeen feet in thickness. In order to get at these mineral treasures, there is no necessity of shafts sunk deep into the earth, nor will machinery be required to pump water from the mines. The region is already *drained to hand.* The coal and iron can be reached by lateral cuts into the hill-sides.

The coal-field extends through the whole length of the valley, and is, therefore, about thirty-four miles long. Its average breadth is four miles; it contains, therefore, about 140 square miles, or 90,000 acres. The capacity of the basin has been variously estimated. One estimate makes the yield of a portion of the field at fifty thousand tons the acre, of *available coals*, lying above the bed of the Potomac. "The resources of this region," says Mr. R. C. Taylor, in his Statistics of Coal, "are demonstrated to be of a very productive character: surpassed, probably, by none on the eastern margin of the Alleghany mountain range."

It is the peculiar character of the coal of the Cumberland region, which gives it, at this juncture, its chief interest. At this juncture, we say, for we seem to be approaching a turning-point in the history of steam-power; a stage when the inquiry as to the future supply of fuel, vegetable and mineral, to supply the fires of the steam-furnace, which burn higher every day, and the consideration of the comparative value and capacity of the different varieties of coal, become matters of no little moment. The value of a large and easily accessible supply of semi-bituminous coal becomes evident from a few obvious considerations.

For all locomotive purposes, whether on land or water, the fuel that is capable of generating the most steam, within the shortest time, at the shortest notice, and at the same time occupies the least space in bulk, is obviously the most desirable. Such is the distinguishing excellence of the semi-bituminous coals. In England the Welsh coals are for this reason called, by way of distinction, *steam* coals. The Cumberland and Welsh semi-bituminous coals prove, upon analysis, very similar in the proportions of carbon, and volatile or bituminous and gaseous matter. Mr. Taylor, in his "Statistics," gives a classification and analysis of some thousand varieties of coals, of the three great classes, bituminous, semi-bituminous, and anthracite, into which they are divided. Of the Welsh coals the average of five varieties is about 81 per cent. of carbon to about 15.5 of bituminous matter. Of the Cumberland, specimens from Savage River contained 77 per cent. of carbon to 16 of bituminous matter, and 78 to 19; Maryland Company's 82.01 to 15; George's Creek, 70.75 to 16.03; Stony River, 83.36 to 13.28; Abram's Creek, 72.40 to 15.20.

The excellence of the Cumberland coal is attested by many men of science. Mr. David Mushet, of Gloucestershire, a few years ago, pronounced some specimens from near the town of Cumberland "the very best bituminous coal he had ever met with," and he considered it well adapted to iron making. Dr. Ure says that it "resembles closely, in external appearance, the outcross coals of the Monkland and Calder district, near Glasgow, so celebrated for making good iron." "Professors Silliman, Shepard, and others, have shown," says Mr. Taylor, "that the main or ten feet Frostberg seam, which, having been longer worked, has conferred a character on the Cumberland coal, contains but 13.34 per cent. of bitumen, besides 1.66 of water. Such an amount as 82 per cent. of carbon, which these analyses show it to possess, while at the same time it retains enough of the properties of flaming coal, carries its own best commendation, and places it very high, if not the highest, in the scale of American coals." Opinions might be added from Prof. Daniel, Major Douglas, Dr. Jackson, Prof. Ducatel, Lieut. Lynch, Prof. Renwick, and others.

Being of an intermediate kind between the anthracite and full bituminous, and having more carbon than the latter, and more bitumen than the former, the semi-bituminous coal possesses a high degree of the good qualities of both, although not so high of either of those of which the others have an excess. It contains these elements in more equal proportions. In anthracite the average of carbon is from 90 to 95 parts out of 100; in bituminous, 45 to 55 out of 100. For extremely hot fires, like that of charcoal, the anthracite is, of course, the best. For a fast open-burning fire of little intensity, the English bituminous coals are best. But used for the purposes of the locomotive engine, propelling either ship or car, the anthracite, although possessing ample evaporative powers, is too difficult to kindle for the despatch and punctuality of travel, and it requires blowers and a strong draft to keep it burning, the consequence of which is, that a large proportion of heat (estimated at 20 per cent.) is lost, so that less steam is obtained than from coals of intrinsically less evaporative power. At the same time, the incomplete combustion of this coal, leading to frequent and inconvenient accumulations, which choke the furnaces, and its tendency to clinker, are almost fatal objections to its use, alike on railways and steamers.

On the other hand, the common English bituminous coal, which has heretofore been much used in steamships, and is very good, has not a few objectionable qualities. The immense volumes of smoke it emits is a point not be overlooked, in connection with its application to naval purposes. The bituminous coal has the advantage of kindling quickly, and it burns fast. But its heating power is less than that of the semi-bituminous, of course much less than that of anthracite. A larger bulk of this coal is, therefore, necessary for the same amount of evaporative power. The tendency of this coal to run together or cake as it burns, is also not to be overlooked. And instances have occurred of bituminous coal igniting by spontaneous combustion on board of ships. This has been the case with vessels

on their way to the East Indies, and a few years ago an English government steamer was burnt in the Mediterranean by the spontaneous combustion of its coal.

In short, for a combination of the highest evaporative power, with the least bulk, facility of ignition, and completeness of combustion, and for the absence of any tendency to clog the furnace, to clinker, or to cake, semi-bituminous coals, for purposes of steam locomotion, must have the preference over the other kinds.

By far the most elaborate experiments on this subject are those conducted under the direction of the naval department at Washington, by Professor Walter R. Johnson, whose elaborate Report of 600 pages lies before us. The results are given in numerous detailed tabular statements. And at the end are the tables, in which are exhibited the character and efficiency of the several coals. The examination embraced over forty specimens, including various foreign kinds. From the first of these we take the following figures, in which the coals are compared with reference to bulk and space required for stowage, proportion of carbon and volatile matter, and evaporative power.

Official Analysis of Anthracite and Bituminous Coal.

	Weight per cubic foot.	Cubic feet per ton.	Fixed carbon.	Bitumen or volatile matter.	Earthy matter.	Evap'ive power.
Anthracites.						
Peach Mountain . . .	53.78	41.64	89.00	2.96	6.13	145
Lehigh	55.32	40 50	89.15	5 25	5.56	835
Forest Improvement . .	53 66	41.75	90.75	3.07	4 41	940
Lackawanna . . .	48 89	45.82	87.74	3.91	6.36	915
Semi-bituminous.						
Neff's Cumberland . .	54.29	41.26	74.73	12 68	10.36	1,000
Maryland Mining Company	53 70	41.71	73.50	12.31	12.44	914
Blosburgh	53.05	42 22	73.11	14.75	10 77	908
Dauphin and Susquehanna	50,54	44.32	74.28	14.75	11.49	
Bituminous.						
Newcastle	50.82	44.08	57.00	35,83	5.40	809
Liverpool	47 88	46 74	54.90	39.96	4.62	733
Sidney	47 44	47 22	67.56	23.80	5.49	747
Pictou	49.25	45 45	60.74	25.93	12.51	792
Richmond, Virginia . .	46 50	48 17	60.30	32.49	8.95	775
Cannelton, Indiana . .	47.65	47.01	58.44	34.00	4.97	686

In the last table the ranks of coals are assigned, according to their practical qualities, in ten different particulars. In respect to completeness of combustion, the second rank is assigned to the Cumberland coal. And it holds the first rank for evaporative power, under equal weights and equal bulks, and for the evaporative power of its pure combustible matter. For freedom from waste in burning, the soft bituminous coals stand first; but some of the Cumberland specimens stand very high, as high as the eleventh of forty-four kinds. And for maximum evaporative power, under given bulks, coal from Cumberland stands first.

At the close of his Report, Mr. Johnson truly remarks, that it is not "easy to assign the exact relative weight or importance of the several qualities indicated. In steam navigation, bulk as well as weight demands attention; and a difference of *twenty per cent.*, *which* experiment shows to exist between the highest and the lowest

average weight of a cubic foot of different coals, assumes a value of no little magnitude.

"For the purposes of steam navigation, therefore, the rank most important to be considered is the fifth, in which the names of coals stand in the order of their *evaporative* power, under given bulks. This is obviously true, since, if other things be equal, the length of a voyage must depend on the amount of evaporative power afforded by the fuel which can be stowed in the bunkers of a steamer, always of limited capacity."—*Hunt's Merchants' Magazine.*

COAL IN ARKANSAS.

THE *Little Rock* (Arkansas) *Democrat* says:—"We have been favored by Mr. Benedict, of Conway County, with a specimen of coal from the vein recently discovered in the Petitjean Mountain, at the confluence of the Petitjean River with the Arkansas. This specimen has much the appearance of anthracite, brilliant and quite heavy. The vein from which it was taken is about five inches thick. Other veins have been found in the same mountain. It is believed that this deposit, being so convenient to navigation, might be worked with much profit."

ANTHRACITE COAL IN MASSACHUSETTS.

PROFESSOR RIDGWAY, of Philadelphia, the gentleman to whom was committed the survey of the coal district of Mansfield, Mass., has reported to the Company. He estimates the amount of coal, on about 1,500 acres of their lands, at 4,000,000 tons. It exists in five beds. One vein is eight feet in thickness. He estimates the difference of cost between the Mansfield and Pennsylvania coal, at Boston, to be $2.20 per ton. Its composition shows 94 per cent. of carbon, and Prof. Ridgway states that it burns with more flame, and ignites more readily, than any red-ash coal he has ever seen.

COAL IN RHODE ISLAND.

THE Rhode Island papers state, that, in digging a well in Bristol, a bed of coal was struck about 14 feet below the surface of the ground, and that it has been penetrated for 12 feet without reaching the bottom of the ledge. The coal has been tried and found to burn freely, without leaving any cinders, and its ashes are of a grayish color. It has not yet been examined by any scientific miner, but the indications are, that the bed extends for a considerable distance. Lumps of from 300 to 500 pounds in weight have been taken out, which are considered as good as the Pennsylvania coal.

THE COAL FORMATION OF AMERICA.

THE coal regions of America are, from the explorations which have thus far been made, supposed to be divided into three principal mass-

es; the great central tract, extending from Tuscaloosa, Alabama, to the west of Pennsylvania, and being apparently continued to New Brunswick and Nova Scotia; the second tract strikes northwestward from Kentucky, crosses the Ohio, and stretches through Illinois to the Mississippi River; a third region, smaller than the others, lies between the three great lakes,—Erie, Huron, and Michigan. Competent geologists affirm, that, from a comparison of the coal strata of contiguous basins, these are no more than detached parts of a once continuous deposit.

The extent of this enormous coal-field is in length from northeast to southwest more than 720 miles, and its greatest breadth about 180 miles; its area, upon a moderate calculation, amounts to 63,000 square miles! In addition to these, there are several detached tracts of anthracite in Eastern Pennsylvania, which form some of the most remarkable coal-tracts in the world. They occupy an area of about 200 square miles.

The strata which constitute this vast deposit comprehend nearly all the known varieties of coal, from the dryest and most compact anthracite, to the most fusible and combustible common coal. One of the most remarkable features of these coal-seams is their prodigious bulk. The great bed of Pittsburg, extending nearly the entire length of the Monongahela River, has been traced through a great elliptic area of nearly 225 miles in its longest diameter, and of the maximum breadth of about 100 miles,—the superficial extent being 14,000 square miles,—the thickness of the bed diminishing gradually from 12 or 14 feet to 2 feet. In 1847 the anthracite coal regions of Pennsylvania furnished 3,000,000 tons, and 11,439 vessels cleared from Philadelphia in that year loaded with the article. The produce in 1848 and the present year is of course larger.

The bituminous coal area of the United States is 133,132 square miles, or one 17th part of the whole. The bituminous coal area of British America is 18,000 square miles, or one 45th part; Great Britain, 8,139 square miles; Spain, 3,408 square miles, or one 52d part; France, 1,719 square miles, or one 118th part; and Belgium, 518 square miles, or one 122d part. The area of the Pennsylvania anthracite coal formations is put down at 437 square miles; and that of Great Britain and Ireland, anthracite and culm, at 3,720 square miles. The anthracite coal of Great Britain and Ireland, however, is not nearly so valuable an article of fuel as the anthracite coal of Pennsylvania, nor does a given area yield so much as the latter.—*New York Express.*

IDENTITY OF SEVERAL DIFFERENTLY NAMED AMERICAN MINERALS.

PROF. B. SILLIMAN, JR., by a series of investigations communicated to the American Association and *Silliman's Journal*, has shown that several American minerals, known and described under different names, are in reality identical. The mineral found disseminated in the white limestone at Bolton, Mass., and to which Prof.

Shepherd has given the name boltonite, is identical with sphene. The bisilicate of magnesia of Dr. Thompson, also found at Bolton, is hornblende, variety actinolite.

The sillimanite of Bowen, the bulcholzite of Brandes, the fibrolite of Bournon, Prof. Silliman shows to be but varieties of the well-known mineral kyanite. Prof. S. remarks, "that andalusite has the same chemical constitution as kyanite, but belongs to the right rhombic form, while kyanite is oblique. Doubtless it is a case of dimorphism, and perhaps the same may be said with truth of staurotide."

ON THE OCCURRENCE OF RARE MINERALS IN THE UNITED STATES.

*Mr. J. E. Teschemacher, in a paper recently read before the Boston Society of Natural History, showed that the mineral called arkansite by Prof. Shepard, recently discovered in this country, is identical with the brookite of European mineralogists. Brookite is oxide of titanium, with traces of iron and manganese, and has hitherto been so extremely rare as to have been only analyzed by Prof. Rosė, of Berlin. It occurs in this country in considerable abundance.

Dr. C. T. Jackson, of Boston, has also found associated with some gold ores from Virginia, the rare mineral tellurium, in the form of a telluret of lead and gold with a little silver and a small amount of selenium. These minerals, tellurium and selenium, have never been found before in America. With some of the specimens Dr. Jackson has also found bismuth, a rare combination.

NEW ADAMANTINE MINERAL.

M. Dufrenoy exhibited before the French Academy, in March, a specimen of a mineral from Brazil, which appears to be to the diamond what emery is to corundum. Among some specimens sent to the "Ecole des Mines" by a dealer in minerals were two, which were stated to be hard enough to polish the diamond; and, in fact, they were found to be harder than topaz. This substance was analyzed by M. Rivot, who had at his disposal one large fragment and several smaller ones. The large fragment appeared to come from the same alluvial formation as that in which the Brazilian diamonds occur. Its edges are rounded by long friction, but it has not the appearance of a rolled flint. It is of a slightly brownish, dull black color, and when viewed with a glass it appears riddled with small cavities, separating very small irregular laminæ, which are slightly translucent and iridescent. The brown color is very unequally distributed throughout the mass, and on the faces the cavities are linear, which gives it a fibrous aspect similar to obsidian. It cuts glass readily, and scratches quartz and topaz; its density is only 3.012, while the smaller specimens are respectively 3.141, 3.416, and 3.255. These numbers indicate a great difference in the porosity of the speci-

mens, but still they lead to the conclusion, that the density is very nearly the same as that of the diamond. The specimens were not altered by a long calcination at a bright red heat, so that they cannot contain any substance volatilizable by calcination. This result renders improbable the idea of Liebig, that diamonds are derived from the transformation of organic vegetable matter. The three specimens were successively burned in pure oxygen gas in the apparatus used for the combustion of the diamond, and 100 of the first specimens gave carbon 96.84, ash 2.03, loss 1.13; in the others the carbon was 99.73 and 99.87, the ash 0.24 and 0.27, and the loss but 0.03 and 0.86. The analysis, therefore, shows that they are composed wholly of carbon and ash. The analysis of the first specimen, however, is believed to be erroneous. The ash was of a yellowish color, and under the microscope appeared to be composed of ferruginous alumina and small transparent crystals.—*Jameson's Journal.*

PLUMBIC OCHRE FROM MEXICO.

We have received from Prof. Baily, of West Point, specimens of plumbic ochre, or native litharge, from New Mexico. He writes concerning it:—"It was given to me by Major Geo. Thomas, of U. S. Army, who got it in New Mexico, where he said it was called 'silver flux,' and used in working silver ores. Thinking it might be only an artificial 'litharge,' I wrote to Major Henry for particulars, and he says, 'I am certain that it is obtained in many places in the province of Chihuahua and Cohahuila. Whilst stationed at Saltillo, I saw some forty or fifty sacks of it which had been taken from a mine near Mazapel, a mining town, some one hundred miles south of Saltillo. I saw a few pieces which had been picked up by officers in the streams between Ceralvo and Monterey, and also in the Sabinas River in the province of Cohahuila. This leads me to suppose this ore occurs in the range of mountains running nearly north and south through Cohahuila, and terminating about twenty-five miles north of the city of Monterey.'" We have examined the specimens sent us by Prof. Bailey, and find them to be yellow oxide of lead. The color is between orpiment and sulphur-yellow, and it glistens like a granular mica of a nearly golden color. The natural surface is slightly crystalline and shining, and when broken it has a scaly texture.—*Silliman's Journal.*

DURABILITY OF STONE.

The Secretary of the Interior, in his report to Congress, says,—"In applying the appropriation for the painting and repairs of the Capitol, it became necessary to examine with care the condition of the walls, and to remove such portions of the stone as were crumbling or falling off in scales, that the coat of paint might be laid upon a sound and solid surface. In this examination it was found that many of the stones, especially those near the base of the building, were

disintegrated at the surface, and some were so much and so deeply affected, that it was necessary to remove them. The Capitol is a massive building, its walls are thick, and maintain a certain equality of temperature, changing slowly with the changes in the temperature of the air. In a change from cold to warm, the walls remain for a time cold, and there is condensed upon them a portion of the moisture of the atmosphere, as upon a pitcher containing ice-water in a sultry day. The stone, being porous, readily absorbs the moisture, and the natural cement, which seems to be slowly soluble in water, is dissolved, or otherwise loses its adhesive power, and the stone crumbles to sand. A thick coat of paint, carefully applied from time to time, has been resorted to, to preserve, and no doubt tends to preserve, the building; but unless some other and more permanent protection be resorted to, it is destined to early dilapidation. If left wholly unprotected from atmospheric action for one fifth of the time that marble structures are known to have stood, this noble edifice would become a mound of sand.

"The Treasury building and the present Patent-Office building are of the same material, and, having been in no manner protected, already show signs of decay. The cornice of the Treasury building, which exposes a heavy mass of stone to atmospheric action, begins to be moss-grown; and pieces of the Patent-Office building have crumbled and fallen. Besides its tendency to disintegration on exposure, the stone in its best condition is weak, offering little more resistance to a crushing force than common brick. These buildings cannot, with all possible care, be long preserved by the means at present adopted. But if the stone could be rendered permanently and absolutely impermeable to moisture, the principal difficulty would be removed, and this may, perhaps, be done by some means known to the arts, or which may be discovered by experiment. For this purpose I would recommend that specimens of the stone be carefully analyzed, and that a series of experiments be tried with a view of finding some chemical agent, the application of which will prevent its absorption of moisture, and thus strengthen and render it durable."

At the meeting of the American Association at Cambridge, in August, Prof. Walter R. Johnson stated that the materials of which the Washington Monument at Washington is being constructed are totally unfit for the purpose. He exhibited specimens of the marble, and mentioned many experiments that had been made, which render it not at all improbable that the monument will fall to pieces from its own weight before it is completed. A specimen of the stone, four cubic inches in dimensions, sustained a weight of only 9,000 pounds, while one cubic inch of good material sustained a weight of 18,000 pounds.

METEORITE IN NORTH CAROLINA.

On the authority of a communication from J. H. Gibbon, Esq., of the Branch Mint at Charlotte, North Carolina, we give a condensed view of facts regarding a fall of meteoric masses in that State.

On Wednesday, the 31st of October, at 3, P. M., several persons

in the town of Charlotte were astonished by a sudden explosion, followed at short intervals by two other reports, and by a rumbling in the air to the east and south. The sounds were distinct, and continued more than half a minute. Some attributed them to thunder, but there were no clouds. A report having reached Charlotte on the following Monday, that "a wonderful rock had fallen from the skies on the plantation of Mr. Hiram Post," Mr. Gibbon, with Dr. Andrews, travelled twenty-one miles for the purpose of seeing the rock. They found it to be a "bluish gritty rock," of irregular form, eight inches long, six broad, and four thick, bearing marks in spots of recent fracture, but otherwise black, as if it had been exposed to heat and smoke, the black color being relieved where the crust had been broken, and a little of the clayey soil in which it was buried in its descent still adhered to it. It had the curved indentations usual in meteorites, as if it had been soft and had yielded to impressions, and lustrous metallic points appeared through the ground color, which had generally a bluish slaty appearance, but no such rock was known in the neighborhood. It was said to weigh 19¼lbs.

Mr. Post took the travellers to see the place where the mass fell. He was at the time in company with a young man; they heard overhead a whizzing sound,—the whole atmosphere appeared to be in commotion, and, though nothing was visible, they heard the stone strike east of them "with a dull, heavy jar of the ground." On the next morning, by sounding with a stick in the hole made by the stone in its fall, they found it, ten inches below the surface, about 300 yards from the point where Mr. Post was at the moment of the fall. The stone is to be sent to Prof. C. U. Shepard, and in due time we shall have the result of his scientific examination; but, from the circumstances, we have no hesitation in admitting the case as genuine.

A later letter from Mr. Gibbon renders it probable, that "luminous materials were seen advancing from several points in the atmosphere towards a common centre, where a solid mass of heated metal exploded, and was violently projected in different directions to the earth." It is stated, also, that there was a distinct appearance of a single fiery elongated body, like iron advanced to a white heat, sparkling in its passage from west to east, rising like a rocket, but not vertically, and passing through the air with a long white streak or tail following a denser body in the form of a ball of fire. At the explosion, the meteor was about 45° high. The estimation of time between the disappearance of the light and the arrival of the sound was very different, some making it as high as five minutes. This is, no doubt, too large, and the meteor was probably not over 15 or 20 miles from the earth when it exploded. It was seen through 250 miles, from the line of Virginia to Sumpter District in South Carolina, and from east to west through 60 miles.—*Silliman's Journal, Jan.*, 1850.

BONE CAVES OF PENNSYLVANIA.

THE following account of the bone caves of Pennsylvania was communicated to the American Association by Prof. Baird.—The

discovery of bone caves in this country is of a very recent date. They have been found for many years in Europe; and in France in great numbers. In this continent there are on record but two cases of this kind; one of them in Canada, the other in Virginia. Within the last two years, caves containing considerable quantities of bones have been discovered in various parts of Pennsylvania, particularly near Carlisle and on the Susquehanna. The principal cave occurs on the bank of the Susquehanna, in the limestone rock, nearly on a level with the water, the entrance being ten feet high. The floor of the cave is nearly on a level with the extremity, and the cave itself is about 300 feet in length. On the bottom is a stratum of mud, in which numerous bones are imbedded, about ten inches in depth. This lies above several other strata of deposits, of stalagmite, &c. There is a series of galleries near the roof of this cave, which can only be reached by ladders, being sometimes eight or ten feet above the floor of the cave. These are filled with mud, and in this mud the bones are distributed. The remains have evidently come in from above, as there is no other possible means by which they could be filled to this height. The character of these remains is quite interesting, in some respects. The number of species of mammalia found there is nearly twice that of the species at present existing in Pennsylvania. Nearly 5 per cent. consist of extinct species; the remaining 95 per cent. are recent. The recent bones are of various species of wolves, foxes, rabbits, bears, muskrats, otters, lynxes, panthers, beavers, &c. Besides the remains of mammalia, there are numerous remains of other vertebrata,—birds in great quantities, particularly wild turkeys, and some of these of an enormous size, probably weighing thirty or forty pounds. There are numerous bones of the swan, several ducks, and some large waterbirds. Prof. Baird has also found the humeri of birds quite as large as the pelican, and the lower jaw of a salamander, quite different from the existing species. Of tortoises there are the remains of eight or ten different ones in great abundance; and the bones of serpents are quite common. Some remains of fishes, vertebræ, and scales, occur mixed with the mud. In that portion of the mud which forms the upper two or three inches of the floor, some Indian remains, such as arrow-heads and fragments of pottery, are very perfectly preserved. In relation to the origin of these bones, Prof. Baird remarks,—"Whence came this vast accumulation of remains? I say 'vast,' because I possess of single species of deers, remains that must have belonged to more than one hundred individuals, and I am very far from having cleared out the cave. Various theories are proposed for the production of the bones. Some geologists have supposed that they have washed in from without; others that they have been dragged in by wild beasts; and this latter theory is strengthened by the fact, that a great majority of the bones are of the weaker animals such as would naturally fall the prey of any carnivorous animal.

"It has appeared to me, from the examination of the peculiar circumstances of the cave, that several causes have combined to furnish this accumulation. I can hardly assent to the theory, that water has

been the means of introducing these bones, for there is no reason why there should be such an accumulation of the bones outside of the cave under any circumstances which would admit of their being washed in. It is quite possible that many of them have been introduced by wild beasts; and some of them bear tooth-marks, which were probably from the teeth of the animals which dragged them within the cave and devoured them there. But I am inclined to think that the principal source of this accumulation is from the sink-holes above, with which these caves connect.

"These sink-holes are curious depressions of the soil, found in limestone regions, varying in diameter from ten feet upwards, with an aperture at the bottom through which the water escapes. They are generally overgrown by small bushes, and are just the places to which such animals as the fox and wolf would resort to feed upon an animal just captured. Its bones would be left, after the repast, either in the hole or upon the side, until some heavy rain should occur, when the water of the surrounding country of which these sink-holes are generally the outlet, would carry them down into the cavity. These sink-holes, in almost all cases, communicate with excavations in the rock or soil beneath; and most of our Pennsylvania caves I believe to have been formed by their action. A rain of unusual violence may close up the inlet into one of these caves and then a new cave will be formed. I have not been able to trace in this cave any communication with the external sink-holes; but I have in other cases, and I have found a little mass of earth at the bottom, and, in many cases, bones introduced there within a few weeks or months, and sometimes even with the cartilage still upon them."

FOSSIL BONES OF THE LARGE BIRDS OF NEW ZEALAND.

At the meeting of the American Association, Professor Chase, of Brown University, exhibited some huge bones of the *Dinornis Novæ Zealandiæ*, which are believed to be the first remains of this gigantic bird which have been brought to this country. They were presented by one of the chiefs of the Northern Islands to Captain Mayhew, of Martha's Vineyard. They belonged to an extinct species of the *Dinornis*, recently described by Professor Owen, of England. There formerly existed upon the islands of New Zealand no less than six different species of the *Dinornis*, the largest of which is believed to have been about eleven feet in height. Though similar in structure and habits to the ostrich, its weight must have been three times as great. Fragments of egg-shells obtained show, by their slight concavity, that they exceeded by far in dimensions the egg of the ostrich; and the young, when first hatched, must have been nearly as large as a full-grown turkey. The foot-prints of this enormous bird probably exceeded in size the largest of those found in the sandstone of the valley of the Connecticut. The second species in point of size was the *Dinornis ingens*. It was about nine feet in height, and was of more robust proportions than the first species. It was to the Dinornis ingens that the largest

bones exhibited to the Association belonged. A tibia of an ostrich, compared with a corresponding bone of this bird, seemed quite diminutive. The *Dinornis strouthoides* was of about the same height as the ostrich, but of stouter proportions. The fourth species, the *Dinornis dromioides*, was of smaller dimensions. Its height may have been between five and six feet, which is the average height of the emu in captivity. The *Dinornis didiformis*, to which another of the tibial bones exhibited belonged, was a little larger than the extinct dodo, to which it bore some resemblance. Its height was about four feet. The *Dinornis otidiformis* was not larger than the great bustard (*Otis tarda*) from which the species is named.

From the circumstances under which the bones of the *Dinornis* are found, as well as from their remarkable preservation, the bird is believed to have been living within the historical period.

A collection of the bones of these enormous birds, amounting in all to 800 specimens, has been received from New Zealand, by Dr. Mantell, of England. The collection includes three distinct types, the particular members of which were of all dimensions, from those of a water-hen to a colossal bird ten or twelve feet high. The state of preservation of the bones is remarkable; they are light and porous, and of a delicate fawn-color, resembling the bones from the caverns of Germany. A recent letter from Mr. Walter Mantell, in New Zealand, gives the particulars concerning their locality and occurrence. They were found near the embouchure of the Waingongora, which rises in the volcanic ridge of Mount Egmont. The river seems recently to have changed its course, probably in consequence of the elevation of the land, and is now cutting through a lofty cliff of loose conglomerate, overlying a finely laminated sand. The latter rests on a blue clay, containing recent marine shells. In a loose sand drift, at the base of an ancient cliff, Mr. Mantell had an opening made, and soon came to the bed containing bones. These were at first so soft, that, if strongly grasped, they fell into clay. Many bones were found,—some of them apparently lying in their natural position; but the natives of the neighbouring villages gathered around him, and began digging themselves, and not only interrupted his researches, but trampled on and destroyed the bones he had laid out in the sun to dry. Along with the bones were portions of egg-shells, one fragment measuring four inches long.

From the examination of these bones, it appears that the beak of the *Dinornis* was like a cooper's adze, and was probably designed to tear up the roots of plants; the base of the skull is prolonged below the foramen magnum, in a very extraordinary manner, for the attachment of powerful muscles, by which the mandibles were acted upon.

Professor Chase intimated that these gigantic birds had probably become extinct through the agency of man, and, in answer to an objection raised by Professor Agassiz, that we have no geological evidence of the existence of man with extinct species of animals, Mr. Mantell replied, that such evidence had recently been discovered. Bones of this character had been found, by his brother, in the bed of

a stream, in some loose sand, where evidently was once the channel of a river. Digging down, he found the evidence of extinct fires; and in these charred places were found bones of this character, together with human bones, those of a dog, the remains of shell-fish, and fragments of egg-shells curved in the contrary direction by the action of fire. The skin and beak of this monster bird had been found in this place. The reason for supposing the animal to have been contemporaneous with man was, that the bones presented a white appearance, which can only be produced by burning the bones while they contain animal matter.

FOSSIL BONES FROM NEW ZEALAND.

A FINE collection of the remains of the gigantic bipeds of New Zealand has recently been received, in England, from Mr. Walter Mantell, of Wellington. The series consists of upwards of 450 bones, referable to several genera of birds; they were obtained from two localities remote from each other, and under very different circumstances. One series is in the same condition as those formerly received by Dr. Mantell, and among which were the skulls and mandibles and egg-shells described by Professor Owen in the Zoölogical Transactions. These are from the west shore of the north island, and were dug up from a bed of marl and volcanic sand. The other series is from a tertiary deposit, on the coast of the south island, at a place called Waikonaiti. These belong principally to the most colossal species of *Dinornis*, the *D. giganteus*. The gems of this collection are two entire legs and feet of the same individual, which were found erect, about a yard apart, in the very position in which they were when the bird was alive; the twelve bones of each foot, together with the tarso-metatarsals, are as fresh and perfect as if inhumed but a few years. Indications of winged birds, of genera, and probably species, still indigenous to the islands, are among these treasures.—*London Literary Gazette, Nov.* 17.

DISCOVERY OF FOSSIL FOOTPRINTS IN THE LIMESTONE OF TEXAS.

A NUMBER of singular footprints of a gigantic size have recently been found in the limestone strata on the Brushy River, Texas. They occur in the soft argillaceous limestone, and are as distinct as if they had been made in plastic clay. The stride is so large that a man of ordinary size can with difficulty jump from one footprint to another. The limestone in which they are found, we believe, is similar to that which extends through Austin, New Braunfels, and Bexar, and from the quarries in this rock, most of the stones in the Alamo, and other buildings of Bexar, were obtained. The strata contain many marine fossils, among which are the ammonite, nautilus, gryphite, &c. These footmarks, like those discovered in the red sandstone formations, were probably made by an extinct species of bird.—*Corpus Christi Star.*

FOOTPRINTS IN THE OLD RED SANDSTONE.

MR. ISAAC LEA, of Philadelphia, gives the following account of the discovery of fossil footprints in the old red sandstone near Pottsville, Pa. In examining the strata in the gorge of the Sharp Mountain, where the Schuylkill breaks through it, he was astonished to find, on a large mass of old red sandstone, six distinct impressions of footmarks in a double row of tracks, each mark being duplicated by the hind foot falling into the impression of the fore foot, but a little in advance of it. The strata were tilted a little over the vertical, and the surface of the rock exposed was about twelve feet by six, the whole of which was covered with ripple-marks and the pit of rain-drops, beautifully displayed in the fine texture of the stone. The six double impressions distinctly showed, in the two parallel rows formed by the left feet on the one side, and the right on the other, that the animal had five toes on the fore feet, three of which toes were apparently armed with unguical appendages. The length of the double impression was 4½ inches, the breadth 4 inches, the distance apart in the length of the animal's step 13 inches, and across from outside to outside 8 inches. The marks of the dragging of the tail were distinct, but occasionally slightly obliterated a small part of the impressions of the footmarks. The footmarks assimilate remarkably to those of the recent alligator of the Mississippi. No such animal remains have heretofore been found so low in the geological series, so that these footmarks are of great interest. Their position was about 8,500 feet below the upper part of the coal formation at Pottsville, and by various measurements about 700 feet below the surface of the old red sandstone. Mr. Lea has named the animal supposed to have made these footmarks *Sauropus primævus.* The limestone of the old red sandstone exists at the locality where the footmarks were found; it is about 2 feet thick, and underlies the footmarks about 65 feet.

DRIFT FOSSILS FROM NANTUCKET.

A LOCALITY of drift fossils has been discovered by Mr. Desor, in a cliff at the east end of Nantucket island. The outlines of the strata of the cliff are somewhat obscured by the sand which has been blown over the surface, but about half way up is an oyster-bed, containing many fossils in a remarkably perfect condition; even crab's claws being found here unbroken. Its position indicates that it has not been disturbed since it was formed. It contains most of the species found on the neighbouring beaches. Specimens of *Venus* are sometimes found with the valves open, as if from the relaxation of the muscles at the moment of death.

Until within a few years, it has been supposed that there were no fossils in the drift south of Lake Champlain. In 1847, Mr. Desor discovered a fossil deposit on Long Island, the origin of which was doubtful, as the shells were much broken and worn. But at Nantucket, a point between these localities, the formation is now found to exist without the least trace of disturbance. The strata at the east

end of this island dip towards the west, the angle of dip gradually increasing from the highest to the lowest. The identity of species between the fossils and the shell-fish now living on the adjacent shores indicates a similarity of climate at the time they were deposited to the present. An opinion has prevailed among geologists, that at the epoch of the drift the climate was colder than it now is.

Above the drift, on the surface of the island, boulders have been deposited. It is an interesting inquiry, how they could have attained their present position, above the bed of fossils, without disturbing them. The regularity of the stratum of sand under them, and the character of the climate, as indicated by the shells, are incompatible with an explanation based on the glacial theory. They could hardly have been brought by icebergs, for among them are masses of pudding stone, such as exist at Hingham and Roxbury, which rest here at a higher level than their source. Beneath the oyster-bank of Nantucket is a stratum of coarse, sandy clay, very much like that at the base of the cliff at Gay Head, which was regarded by Prof. Hitchcock as a tertiary deposit. It is probable that these two formations are the outcrops of a tertiary basin which passes underneath the two islands of Nantucket and Martha's Vineyard and the intervening sea.

DISCOVERY OF FOSSIL REMAINS IN THE VALLEY OF THE CONNECTICUT.

In the fall of the year 1848, an interesting discovery of fossil bones was made in the new red sandstone of the valley of the Connecticut, at South Hadley, Mass. The workmen employed in excavating a canal brought to light, at a distance of a few feet below the surface, a nearly perfect skeleton of some unknown animal. Unfortunately, in the absence of the engineer, the bones were all destroyed. The rock in which they occurred is a bluish shale, and contains impressions of plants, grasses, &c. They were described, by those who saw them, as of a large size, one of them equalling the leg-bone of a horse. Their loss is highly to be regretted, as they would have probably thrown some light on the nature of the animals whose footprints are found so abundantly on the rocks of the Connecticut valley.—*Editors.*

FOSSIL CRINOIDS OF THE UNITED STATES.

At the meeting of the American Association, a paper on the Fossil Crinoids of Tennessee, by Prof. Troost, was read by Prof. Agassiz. These fossiliferous remains were discovered in the carbonaceous and silurian strata of the State, and show a wonderful development of that form of animal on the shores during the paleozoic period. Thirty-one genera, sixteen of which are considered by Prof. Troost as new, are enumerated. The species embraced are not less than eighty-eight in number, of which only half a dozen have been described. It is the opinion of Prof. Hall, that all the silurian forms-

tions of New York will not afford more than sixty species,—twenty-seven of which have been found in a space not exceeding 100 feet square. The number of species that were known in the State of New York, previous to the beginning of the geological survey, did not exceed four or five. Now about sixty species have been ascertained. Prof. Hall mentioned the fact, that all the crinoids of the lower silurian rocks, with the exception of one species, have five pelvic plates, and we never find one with three, or any other number of these plates, before we reach the highest deposits. In Tennessee the crinoids are so abundant, that Prof. Troost states that he had been able to collect some 300 or 400 good specimens of 7 or 8 different species in a single morning. In relation to the abundance of these fossils in the United States, Prof. Agassiz remarked, that it is not, perhaps, sufficiently appreciated of what importance and of what immense value the study of these fossil crinoids may be for the progress of palæontology. American students should be proud of these materials, by which they will be able to throw so much light upon these almost extinct families by their personal investigations, which will not only render them independent of the paleontologist from abroad for information with regard to the succession of types, and the full illustration of these structures, but really afford correct standards for comparison. It is the more desirable that all these fossils should be made known, as the family of crinoids is so reduced in our days that we can form no idea of the living animals of that group, of their diversity of form, modification of character, and peculiarity of position, from the living type only. He doubted whether the number of crinoid heads of all species found in Europe, now existing in the museums of Europe, is one third the number of those which have been found by a single gentleman in Tennessee in one morning. Now with such materials, consider what precise and what minute investigations could be made. And if these facts could be once fully ascertained and well illustrated, there is no doubt that the series of crinoids, and their succession in former ages, will be established from American standards, and will no longer rest upon the European evidence, which has often been derived from the examination of small fragments of those ancient fossils, found in unconnected basins for the most part, so that their geological succession could be ascertained only with great doubt and difficulty. In conclusion, Prof. Agassiz would venture to say, that geologists who have had any opportunity to compare the position of the ancient rocks on this continent with the corresponding deposits of Europe, would agree with him in saying that the geology proper, the stratography of this continent, will afford the same precise and well-authenticated standards for the appreciation of the order of succession of rocks, as fossils will for the order of succession of living beings.

THE FOSSIL BOVINE ANIMALS OF SCANDINAVIA.

PROF. NILSSON, of Lund, in his "*Skandin's Daggdjur*," has an account of the bovine animals of Scandinavia, in which he makes some

interesting observations on the fossils of that species, but he confines himself mostly to a colossal ox, which he supposes to be the *Urus* mentioned by Cæsar in his Commentaries. This colossal species of ox, to judge from the skeleton, resembled the tame ox in the form and the proportions of its body, but in its bulk it was far larger. According to all accounts, the color of the ox was black, and it had white horns, with long black points; the hide was covered with hair like the tame ox, but it was shorter and smooth. The whole length of one skeleton, which was not full grown at the time of the animal's death, from the nape to the end of the rump bones, is 9 feet, and, with the head, the whole length of the animal is about 12 feet, while the height is 6 to 6½ feet. The circumference of the crown of the horn is 14 inches, the length of the spinal column 7 feet 7 inches, and the greatest length of one of the middle ribs 2 feet 5 inches. It will thus be seen that Cæsar's remark, that it was "in size little inferior to the elephant," was not so much exaggerated as some have supposed. We have good proof that this colossal species of ox has lived in Europe since the country has been inhabited by men, for a few years since a skeleton was found, one of the bones of which has in it the wound caused by some weapon, which anatomists all agree must have been thrown by the hand of man.

THE TRILOBITES OF BOHEMIA.

M. Barrande, of Prague, who is preparing a work on the Silurian System of Bohemia, in studying the numerous trilobites which he has collected in that country, has made a remarkable discovery in respect to these, the most ancient fossil crustaceans known. He has traced for the first time the developement of a trilobite from its embryonic state to its adult condition, and has observed twenty successive stages, during which this one species undergoes very remarkable changes of organization, passing from a simple disk-like body to a fully formed trilobite, with seventeen free thoracic segments and two caudal joints. This discovery is highly important to geologists, as it diminishes the number of the so-called species, it being ascertained that, in a recent work on these same trilobites of Bohemia, the authors made no less than ten genera and eighteen species out of a part only of the stages of metamorphosis of the single individuals.—*London Athenæum, July* 7.

FOSSIL APE.

M. Paul Gervais has just discovered, in the upper tertiary stratum of Montpellier, in France, a species of fossil ape, probably belonging to the *macaque* genus. On comparing this discovery with previous ones, it appears that fossil apes have been discovered in the three principal tertiary strata of Western Europe, that is to say, in every part of the level of sedimentary earths in which the bones of mammalia abound. If man had existed at the period when these strata were deposited, the non-discovery hitherto of the slightest trace of

human skeletons, or remains attesting human industry, would be very astonishing. The discovery of these fossil apes is, therefore, an additional indirect proof of the very inferior antiquity of man on the earth.—*Le Constitutionnel.*

INTERESTING FOSSILS.

The Potsdam sandstone, which forms the basis of the lower silurian rocks of the New York series, has usually been considered to be the oldest of the fossiliferous rocks in the geological formations of this country. Mr. Desor, at a meeting of the Boston Natural History Society, in November, stated, that there had recently been discovered on the St. Croix River, eight hundred feet below the Potsdam sandstone, a still more ancient rock containing several species of fossils. Specimens of lingula, in a fine state of preservation, were exhibited, and trilobites have also been found. These interesting remains are probably the earliest representatives of animal life on this continent.

FOSSIL WHALE IN VERMONT.

The workmen on the Burlington and Rutland Railroad, while digging, a short time since, in Charlotte, about twelve miles south of Burlington, came across the skeleton of some unknown animal, deeply imbedded in a fine adhesive blue clay. Little attention was paid to the matter at the time, and unfortunataly most of the bones were carted off. Enough of them, however, have since been obtained, by the Rev. Mr. Thompson, to enable him to determine all the important characteristics of the animal to which they belonged, and to give a drawing representing its proportions. He states that the bones discovered are those of a cetaceous animal (or some sea animal of the whale kind), resembling the Dolphin. Prof. Agassiz, after a careful examination of the bones, has arrived at the conclusion, that it is an arctic species, nearly allied to the *Delphinus leucas*, or grampus. In size it was about eleven feet in length, and six feet in circumference. The bones found were in a tolerably good state of preservation. The skull was badly broken by the workmen, as well as the ribs. Nearly all the vertebræ were obtained, as well as half the lower jaw, one long rib, an anterior rib, some teeth, the sternum, and portions of the arms and paddles. The formation in which it occurred is the post-pliocene. The locality is about one mile from Lake Champlain, 60 feet above the level of the lake, and 150 above that of the sea; associated with the bones were several varieties of shells, mostly of arctic species, and impressions of flags or grasses. Mr. Thompson considers that the animal was imbedded in a sort of marsh, in which the rushes were growing, on the borders of an estuary, or strait of the ocean, of which the present bed of Lake Champlain formed a part. In support of this view, he mentions, in addition to what is stated above, that it was buried 8 feet deep in the quagmire, and below it were rounded pebbles.

FOSSIL ELEPHANT IN VERMONT.

At the meeting of the American Association, Prof. Agassiz exhibited the tooth and tusk of an elephant recently discovered in Vermont. It was found in the construction of the Rutland and Burlington Railroad, upon the slope of Mount Holly, one of the highest mountains in Vermont, and, it is said, under erratic boulders. The specimens in question had been presented to the Lawrence Scientific School, by Mr. Samuel Henshaw, of Boston. Professor Agassiz remarked, that this was the first true elephant found in a fossil condition in the Northern American States, and was of a different species from that found in the caves of Kentucky. It was a question, whether this was identical with the fossil European elephants or not. He deeply regretted that there were no specimens with which he could compare these teeth, but he would venture, from recollection, to predict that, upon direct comparison, they would be found to differ from the European, in the same proportion that the mastodons differed. He thought these grinding-teeth had much narrower lamellæ, and that the tusk was much more slender. The curve of the tusk was scarcely greater than in the Asiatic elephant, while the European fossil was much more curved.

Professor Rogers remarked, that he had already, several years since, presented his views to the Association respecting the physical geography of this part of the United States, at the era of the drift. He had shown that New England and New Brunswick constituted an island, detached from the continent, like Great Britain at the present day. From the researches, chiefly of Mather, Emmons, and others, we must now admit that there were two drifts. Up to the time of the first, the mastodon could not have crossed the straits.

Dr. Warren remarked, that this discovery formed an epoch in the palæontology of New England. North river seemed to have separated the animals of New England from those of the continent.

THE FOSSIL RHINOCEROS OF SIBERIA.

Mr. Brandt, at the request of Humboldt, has communicated to the St. Petersburg Imperial Academy the results of his microscopic examination of the remains of food in the hollows of the teeth of the antediluvian rhinoceros, of which the Academy possesses a complete cranium still covered with the skin. It appears that this species of rhinoceros fed on the leaves and fruit of coniferous plants, so that there is no reason for supposing that the fossil animals found buried in arctic countries have ever lived in a tropical region. The bushy hair with which they were clothed, and the examples of mammoths found in an upright position, rather incline him to adopt the opinion that they lived in the countries and climate where they were found, than to have recourse to the hypothesis either of a sudden change of temperature in the climate, or of the transportation of their remains from a far distant country.—*Jameson's Journal, July.*

WHAT BECOMES OF THE SKELETONS OF WILD ANIMALS AFTER DEATH?

THE curious in natural history have frequently noticed, that they never met with, in the fields or forests, the skeletons of animals, such as hares and rabbits, that live in a natural state, and though rewards for such skeletons were offered to gamekeepers and others, none were ever brought to them. The Count de Montlosier had noticed this curious fact, and it had occurred to him to examine various caves in the neighbourhood of his residence, but he found no skeletons, till one day he entered a cave which had previously been passed over on account of its small entrance, and there he discovered a vast number of skeletons, which appeared to be those of hares or rabbits. The bones were perfect, and the cartilages preserved, showing that they could not have been brought there by any beasts of prey. This fact is stated in the Count's recently published memoirs.—*Ibid.*

FOSSIL ELEPHANT AND MASTODON FROM AFRICA.

M. GERVAIS stated to the French Academy, on March 12th, that he had just received from Algiers a drawing of the molar tooth of a fossil elephant, whose genus is very easily recognized, and which indicates a species more resembling those found in a fossil state in Europe, than the present African elephant. This tooth was found at Cherchell, in the province of Oran. Sicily has hitherto been the southernmost point on the Mediterranean where the fossil elephant has been found.

At the same time he also mentioned the discovery, near Constantine, of some fossil remains of mastodons. Though fossil remains of this animal have been previously found in all the other portions of the world, these are the first discovered in Africa. The remains found are a tooth and a rib, and, as far as can be judged from a drawing, they belonged to an animal more resembling the *Mastodon brevirostre*, or the *arvernensis*, than the *Mastodon angustidens*.

MAMMALIAN REMAINS IN NEW YORK.

PROFESSOR REDFIELD exhibited to the American Association specimens of mammalian remains, which had been found in Broome County, on an elevated ridge separating the Delaware from the Susquehanna Rivers. Whatever causes, observed Mr. Redfield, may be assigned for the occurrence of these animal remains in this locality, we must admit that this deposit took place at a period anterior to that in which the present level of the railway and the general surface of the country adjacent became covered with the drift in its existing form; or at least anterior to the vast period in which the incumbent materials, forty feet in depth, have been accumulated. The overlying deposits appear not to differ materially from those which cover many other portions of the contiguous country; while there are other portions, more exposed, in which large and rounded boulders and worn pebbles are thickly dis-

persed. He also presented specimens of fossils, taken from two boulders of rocks in the drift of Orange, N. J., which belong, generally, to the Delthyris limestone and Oriskany sandstone of the New York system. These boulders must have had their origin at some point not less distant than the valley of the Rondout, the nearest outcrop of these rocks, having thus been carried over the highlands by the active agencies of the drift period.

DISCOVERY OF ANOTHER HUGE FOSSIL REPTILE.

Dr. Mantell has added to his interesting discoveries of fossil lizards, an arm-bone, or humerus, fifty-four inches long. "It is closely allied, in form and proportion, to the humerus of a crocodile." Dr. M. has sent to the Royal Society a memoir on the subject of this new species, and it will probably be soon published.—*Silliman's Journal, Jan.*, 1850.

ON THE GENERA OF MOSASAURUS.

According to Dr. Gibbes, of South Carolina, remains of eight species or genera of mosasaurus have been found in the United States. The relics found in New Jersey have been determined by Professor Agassiz to belong to only one species. Those of another species were found on the Upper Missouri, and have been carried to Europe. These remains were very perfect and valuable, and are now in the Museum at Bonn. Dr. G. has described a small species from Alabama, another from South Carolina, and a third from Georgia. Three genera of mosasauroid fossils, from Alabama and South Carolina, have been also found and described.

INFUSORIAL DEPOSITS ON THE RIVER CHUTES, IN OREGON.

In a paper on this subject, read before the Academy of Berlin, Ehrenberg first draws attention to the results of his former researches, that the rocky mountains are a more powerful barrier between the two sides of America than the Pacific Ocean is between America and China; the infusorial forms of Oregon and California being wholly different from those of the east side of the mountains, while they are partly identical with Siberian species. This fact is confirmed by his examinations of earth from the gold region of California, and from the Chutes River of Oregon, obtained by Fremont. The latter deposit is situated at an elevation of 700 or 800 feet, and constitutes a bed, 500 feet thick, of porcelain clay. It is overlaid by a layer of basalt 100 feet thick. Ehrenberg has made out seventy-two species of polygastrica, with siliceous shells, sixteen species of phytolythuriens, and three of crystalline forms. The *Discoplea* and *Raphoneis Oregonica* are the only two species characteristic of the locality. The beds are more recent than those of the Klackamus River, a few miles from the falls of the Willammet.—*Silliman's Journal, Jan.*, 1850.

BOTANY.

ON THE DIRECTIONS ASSUMED BY PLANTS.

We find, in the *Philosophical Transactions* for 1848, an interesting paper by Professor Macaire, of Geneva, in Switzerland, on the directions assumed by plants in growing. The author first examines experimentally into the causes of the *curling up of the tendrils*, which Knight endeavored to explain by the unequal action of the light on both sides of the tendril, and which was attributed by De Candolle to the obstacle afforded to vegetation by the contact of the leaf-stalk with the body adhered to, on the side where it touches. Prof. Macaire selected, to experiment upon, a common Swiss weed, and he found, that, when the tendril is touched by any solid body whatever on a point of the surface not too far from the extremity, it at once contracts on one side, so as to form a curve over the surface of the body, and to embrace it closely, till seven or eight coils have been formed around it, and this is done so rapidly, that three turns of the helix are sometimes made in fifteen minutes. The nature of the body presented has no influence on the process, the tendrils coiling as rapidly over one substance as another. As these and other phenomena cannot be accounted for by any action so slow as the ordinary process of nutrition, it seems necessary to admit the existence of irritability as a vital property inherent in the tissues of the tendril; this property is found to cease when the tendril is separated from the parent, and, like the irritability of sensitive plants, it is excited, modified, and even suspended or destroyed, by the influence of vegetable or mineral poisons.

The next subject examined is the *inclination of stems towards the light*, which De Candolle ascribed to the more rapid and more complete solidification of the tissue by exhalation and fixation of carbon on the side of the stem exposed to the light. Prof. Macaire first inquires, if such a special attraction is exercised by light on the green parts of a plant as to cause the entire plant to move towards light, if permitted to do so; and his experiments on duck-weed, and on germinating plants of various kinds, attached to cork floats, lead him to a negative

conclusion. He found that, however long it might be necessary for a stem to grow in order to reach the light, its base attached to the float always remained on the same spot. In one instance, a germinate seed of mustard having been placed on a float in a tumbler surrounded by dark paper, but near an aperture admitting luminous rays, the plant put forth a stem, which passed all round the tumbler to spread its leaves in the part of the vessel in which was the luminous aperture; once there it did not extend itself beyond it, but grew erect, although the light was not strong enough to render it entirely green. Thus, although a slight motion of the float would have brought the entire plant within range of the light, its position remained wholly unchanged. The observations of Prof. Macaire are opposed to the hypothesis of De Candolle in this case, as in the preceding, since he found that the stems grew straight towards the light, without the incurvation or bending which that hypothesis assumes. Where young plants already vigorous were placed on the floats in the dark portion of the vessel, their green stems took little or no ulterior development, but from the neck of the root there grew out another stem, white and etiolated, which spread itself along the water to reach the light portion of the vessel, where it grew erect, and put forth its leaves.

The next subject examined was the *direction of the leaves*, that is, the tendency of those which have two surfaces of different hues to expose the deeper-colored to the sky, and the paler to the earth. Prof. Macaire's experiments lead him to the same conclusion that other physiologists have come to, that light is the only agent in turning over the leaves, and that it does not act by a physical attraction, properly so called, but by its influence upon the individual parts of the tissues on which it falls. This influence is the more rapid and energetic, all other circumstances being alike, the greater the difference between the two surfaces of the leaves experimented on. It was maintained by Bonnet and Dutrochet, that the turning over of the leaves always takes place by a flexion or tension of the footstalk; but Prof. Macaire has demonstrated, that the flat portion of the leaf, or even a separate portion of it, can turn itself over. Thus, when an entire branch of geranium was immersed in water in such a way as to expose the under surface only of its leaves to the light, all the young leaves turned themselves over in three days, by moving on the point of insertion of the flat part of the leaf into the footstalk; and in other experiments, in which, by means of a screen, the light was prevented from falling upon the upper surface of the leaves, and by a mirror was directed to the lower, the margins of the leaves bent down in such a manner as to bring their upper surfaces within the influence of the mirror. Upon repeating these experiments, with glasses of different colors, it was found that the leaves turned over most readily in blue rays, and next in violet, but that they remained motionless in red.

Prof. Macaire next inquires experimentally, how far these results are attributable to the influence of light on the nutritive functions, in which the leaves are concerned, and comes to the conclusion that their explanation is to be sought here. He found that the exhalation of fluid from the leaves is always greatly augmented by the ex-

posure of their under surfaces to light, the increase being double, triple, or even more. It is obvious, that this is one principal cause of the unhealthiness of leaves, which results from the inverted position being forced upon them. Another cause is to be found in the diminution of the rate of decomposition of carbonic acid, which takes place under the same circumstances, and to about the same extent. According to Prof. M., the exhalation is greater under blue glass than it is in diffused light, and the difference in the amount of it from the upper and under surfaces respectively is most strongly marked; on the other hand, the amount of exhalation under red glass is reduced to about a sixth, and the difference between the quantity exhaled from the two surfaces is proportionably lessened.

THE POLAR PLANT.

At the last meeting of the American Association, a communication on the polar plant was presented from Major Alvord, U. S. A. This plant, which is also known as the compass plant, derives its name from the fact, that its lower leaves are said to present their faces uniformly to the east and west, the plane of the leaf being north and south, or coinciding with the meridian plane. It is found abundantly in various portions of the West, particularly in the vicinity of Fort Leavenworth, in Southern Michigan, and on the prairies generally from Texas to Iowa. In the valleys, or lower portions of the rolling prairies, where most sheltered from the winds, the polarity of the leaves is most accurate, and the plants are seen arranged all parallel to each other. This is true of the radical leaf, from one to two feet in height, before it grows up to the flowering plant, as it does in the second year. The peculiarities of the plant are well known and recognized by the hunters, trappers, officers of the army, and others, who have traversed the prairies, and it is said that the Indians are accustomed to make use of it as a guide in cloudy weather. As the polarity of the plant has been called in question by some distinguished botanists, Major Alvord referred to the statements of numerous distinguished officers, none of whom, in any of their prairie expeditions, have ever noticed a departure of the leaves from their direction, except when there was some assignable cause apparent to interfere with its growth, such as winds, the trampling of buffalo, or cattle, &c. In endeavoring to account for this seeming polarity, some have suspected the presence of iron, in some of its compounds, in the plant, but a careful analysis with the most delicate tests gave no trace of it. Others have conjectured that the polarity is due to electrical currents, as the plant is full of resinous matter, and is sometimes called the *rosin-weed.*

A note from a gentleman in Wisconsin was then presented by Dr. Gray, which describes the plant as follows:—"The large radical leaves of this species of the sun-flower tribe, when growing in tufts or bunches on the dry, open prairies, rise so much above the grassy turf as to form conspicuous objects; and when thus exposed, they generally present their flat surfaces towards the rising and setting sun,

—thus turning their numerous pointed lobes towards the north and south. Hence it is called the 'compass plant,' and is useful as a guide across the prairies." Dr. Gray stated, that it is a well-known fact, that leaves ordinarily turn their upper surface to the light; but vertical leaves, as those in question incline to be, tend to take a position which exposes the two surfaces equally to the light of the sun; and such upright radical leaves, by presenting their surfaces to the east and west, most nearly fulfil this condition. In the specimens of this plant growing in the Botanic Garden, at Cambridge, Mass., the leaves are quite as frequently turned in other directions as towards north and south, or do not present the edges of their leaves in any one plane more than in another. Dr. Gray alluded to the common belief, that the sun-flower turns towards the sun, and said that the fact had found its way into poetry, and out of the domain of science, and is now regarded in scientific works, as a popular fallacy. The heavy sunflower stands in unstable equilibrium on its stalk, and is liable to nod by its own weight. Doubtless it is more apt to droop towards the sun than in any other direction, simply on the ground of the sun's action on a sultry day promoting the exhalations from the side of the stalk on which it shines, wilting it, as it were. But that it follows the sun in its diurnal course, is not believed to be the fact.

Prof. Morris, of Jackson, Miss., remarked, that in journeying upon the prairies, for several years, he had observed that in running compass lines north and south, the edge of the leaf was seen, so that the plant was not at all conspicuous; but in running lines east and west, the whole plant was seen, and it was a very conspicuous object. The botanical name of this plant is *Silphium laciniatum*.

THE ROSE.

Prof. Agassiz, in a lecture upon the trees of America, stated a remarkable fact in regard to the family of the rose, which includes among its varieties not only many of the most beautiful flowers which are known, but also the richest fruits, such as the apple, pear, peach, plum, apricot, cherry, strawberry, raspberry, blackberry, &c.; namely, *that no fossils of plants belonging to this family have ever been discovered by geologists!* This he regarded as conclusive evidence, that the introduction of this family of plants upon the earth was coeval with, or subsequent to, the creation of man, to whose comfort and happiness they seem especially designed by a wise Providence to contribute.

THE MANNA OF THE ISRAELITES.

At the conclusion of a paper read before the British Association, by Giles Mumby, Esq., on the "Botanical Productions of the Kingdom of Algiers," we find the following passage:—"I shall conclude this paper by noticing a lichen called *L. esculentus*, and which agrees, at least more nearly than any other substance hitherto discovered, with the description of the manna on which the Israelites fed during their *wanderings* in the desert. This lichen is found on the sand of the

desert, which it covers in some parts, and grows during the night, as do many mushrooms. The French soldiers, during an expedition towards the south of Constantine, actually subsisted upon it for some days, cooking it in various ways, and even making it into bread. I do not pretend to explain the miraculous portions of the history of the manna, nor the double quantity gathered on the sixth day. There are a few characters in the account given by Moses which disagree with the substance I have presented to you, yet the discovery of a substance springing up in the short space of a night, on the surface of the sandy desert, and that substance capable of sustaining human life, is, to say the least, a remarkable fact, and one well worthy the examination and researches of botanists."

A NEW SPECIES OF MANNA.

ALL the mannas are saccharine exudations of plants, and resemble each other very closely in their chemical constitution. Their principal constituents are gum, sugar, and the substance called mannite, which derives its name from its source, and has been hitherto considered as the peculiar characteristic of manna. Dr. Thomas Anderson, a Scotch chemist, has, however, recently analyzed a specimen of manna from the interior of Australia Felix, which does not contain any mannite. It is found in great abundance on the leaves of the young mallee plant. The natives call it *lerp*; it is "very sweet, and is formed by an insect on the leaves of gum-trees; in size and appearance like a flake of snow, it feels like matted wool. and tastes like the ice on wedding-cake." It is very nutritive, and adheres to the leaves so slightly, that it is washed off by rain. In opposition to the opinion, that it is the product of insects, the natives assert that it is the spontaneous production of the mallee or gum scrub, and that it grows on both sides of the leaves. On a chemical examination, the lerp is found to consist of small conical cups, covered externally with a number of white hairs curled in various directions; the hairs are not distributed over the whole external surface, but are usually attached to the middle portion. The cups adhere loosely to one another by the edges. Under the microscope, each hair is seen to form a uniform tube, presenting a granular structure. The hairs and cup are colored blue when touched by iodine, indicating that they contain starch. The sweet taste is confined to the hairs. In fact it differs both in form and chemical constitution from all other mannas, as has been found by long examination. The question of the origin of the lerp is a subject of great difficulty, for, as it is in part insoluble, we cannot suppose that it exudes from a leaf when punctured by some insect, as is the case with the other mannas. Chemists who have examined it assert that it cannot be the product of an insect, while, on the other hand, some entomologists have gone so far as to establish, on the strength of it, an entirely new genus of insects.—*Jameson's Journal, July.*

THE LOTUS, AND THE STAPELIA.

"Many opinions have been given as to the fruit called *lotus*, described by Herodotus, Pliny, Theophrastus, and other ancient writers, and which gave its name to a whole people, who were called *Lotophagi*. I have received from M. Pelisier, Consul of France at Soussa, near Tripoli, specimens of a plant called *Nitraria tridentata;* it is a small prickly shrub, agreeing in description with the lotus of the ancients, and, moreover, the fruit is pleasant to the taste, and has a slightly intoxicating property, quite sufficient to make a man forget his country whilst under the influence of it; it is called by the Arabs *damouch*. I think this plant has greater claims than any other to be the lotus, both from the description of the plant and fruit, and also from its geographical position, the region of the Lotophagi being to the eastward of the kingdom of Algiers.

"I cannot pass over a new species of Stapelia, named by Decaisne *Boucerosia Mumbyana*, and discovered by me in the neighborhood of Oran, which is interesting in a geographical point of view; it is well known that the great seat of Stapelias is at the Cape of Good Hope, and, until lately, only one species occurred in Europe as a representative of this genus; I speak of *Stapelia Europæa*, which is found in Sicily, and on the southern coast of Spain. The discovery of an allied species, on an intermediate point, is, I conceive, very interesting, and will in all probability form the second link in a chain which will connect the humble *Stapelia Europæa* with the remarkable Cape species."—*Mr. G. Mumby, before the British Association.*

THE APPLE OF SODOM.

April 28. We picked up a large piece of bitumen on the sea-shore to-day. It was excessively hot to the touch. We gathered also some of the blossoms and the green and dried fruits of the osher for preservation. The dried fruit, the product of last year, was extremely brittle, and crushed with the slightest pressure. The green, half-formed fruit of this year was soft and elastic as a puff-ball, and like the leaves and stem, yields a viscous, white, milky fluid, when cut. Dr. Robinson very aptly compared it to the milkweed. The Arabs consider this fluid a cure for barrenness.

This fruit is doubtless the genuine *apple of Sodom*, for it is fair to the eye and bitter to the taste, and, when ripe, is filled with fibre and dust. Four jars containing specimens are placed in the Patent-Office at Washington. The first notice taken of the apple of Sodom is by Josephus, who says that they have a color as if fit to be eaten, but, if plucked, they dissolve into smoke and ashes. Tacitus mentions them, as does De Chartres in 1100, and, later, Baumgarten and others. Yet many have heretofore derided their accounts as fabulous, and among those who believed them to be true, there has been a great difference of opinion as to the class of fruit to which the apple of Sodom belongs. One considered it the fruit of a hawthorn, and another, of a species of *solanum*, and with this opinion Linnæus agreed. Others re-

referred it to the fig-tree or the pomegranate. The plants which we saw, in various places along the shores of the Dead Sea, resemble very closely the milkweed, which is so common in the United States: it is, in fact, a closely allied plant, being the *Asclepias procera* of the earlier writers, now, however, forming part of the genius *Calotropis.* This plant occurs in many parts of the East, and was known as early as the time of Theophrastus. It is a tall, perennial plant, with thick, dark green, shining, opposite leaves, on very short footstalks; the flowers are interminal, and have axillary umbels of a purple color, containing numerous flattened, brown seeds, each furnished with a silky plume or pappus. The bark, especially at the lower part of the stem, is cork-like, and much fissured. If it be cut, or a leaf torn off, a viscous, milky juice exudes, which is exceedingly acrid, and even caustic, and is said to be used in Egypt as a depilatory. In Persia, this plant is said to exude a bitter and acrid manna, owing to the puncture of insects. Chardin says that it is poisonous. Both the plant and its juice have been used in medicine, and probably are identical with the mudar, or madar, of India, which has attracted so much notice as a remedy for diseases of the skin.—*Condensed from Lynch's Expedition to the Dead Sea.*

ALPINE FLORA OF MOUNT WASHINGTON.

THIS highest region [of Mount Washington] is characterized by an assemblage of Alpine or arctic plants, and by a variety of mosses and lichens specifically identical with those of Northern Europe. The flora of the uppermost region of Mount Washington consists of species which are natives of the cold climate of Labrador, Lapland, Greenland, and Siberia, and are impatient, says Bigelow, of drought, as well as of both extremes of heat and cold; they are, therefore, not at all fitted to flourish in the ordinary climate of New England. But they are preserved here, during winter, from injury, by a great depth of snow, and the air, in summer, never attains, at this elevation, too high a temperature, while the ground below is always cool. When the snow melts they shoot up instantly, with vigor proportioned to the length of time they have been dormant, rapidly unfold their flowers, and mature their fruits, and run through the whole course of their vegetation in a few weeks, irrigated by clouds and mists.

If we attempt to speculate on the manner in which the peculiar species of plants, now established on the highest summits of the White Mountains, were enabled to reach those isolated spots, while none of them are met with in the lower lands around, or for a great distance to the north, we shall find ourselves engaged in trying to solve a philosophical problem, which requires the aid, not of botany alone, but of geology, or a knowledge of the geographical changes which immediately preceded the present state of the earth's surface. We have to explain how an arctic Flora, consisting of plants specifically identical with those which now inhabit lands bordering the sea, in the extreme north of America, Europe, and Asia, could get to the top of Mount Washington. Now, geology teaches us that the species

living at present on the earth are older than many parts of our existing continents; that is to say, they were created before a large part of the existing mountains, valleys, plains, lakes, rivers, and seas were formed. In 1833, I announced my conviction that such must be the case in Sicily. And a similar conclusion is no less obvious to any naturalist who has studied the structure of North America, and observed the wide area occupied by the modern or glacial deposits, in which marine fossil shells of living, but northern, species are entombed. It is clear, that a great portion of Canada, and the country surrounding the great lakes, were submerged beneath the ocean when recent species of mollusca flourished, of which the fossil remains occur more than 500 feet above the level of the sea, near Montreal. Lake Champlain was a gulf of the sea at that period, large areas in Maine were under water, and the White mountains must have constituted an island, or group of islands. Yet, as this period is so modern in the earth's history as to belong to the epoch of the existing marine fauna, it is fair to infer that the arctic flora, now contemporary with man, was then also established.

A careful study of the present distribution of animals and plants over the globe has led nearly all the best naturalists to the opinion, that each species had its origin in a single birthplace, and spread gradually from its original centre, to all accessible spots fit for its habitation, by means of the powers of migration given to it from the first. If we adopt this view, or the doctrine of "specific centres," there is no difficulty in comprehending how the *cryptogamous* plants of Siberia, Lapland, Greenland, and Labrador scaled the heights of Mount Washington, because the sporules of the fungi, lichens, and mosses may be wafted through the air for indefinite distances, like smoke. But the cause of the occurrence of arctic plants of the *phænogamous* class on the top of the New Hampshire mountains, specifically identical with those of remote polar regions, is by no means so obvious. They could not, in the present condition of the earth, effect a passage over the intervening low lands, because the extreme heat of summer and cold of winter would be fatal to them. We must suppose, therefore, that originally they extended their range in the same way as the flowering plants now inhabiting arctic and antarctic lands disseminate themselves. The innumerable islands in the polar seas are tenanted by the same species of plants, some of which are conveyed as seeds, by animals, over the ice, when the sea is frozen in winter, or by birds; while a still larger number are transported by floating icebergs, on which soil containing the seeds of plants, may be carried, in a single year, for hundreds of miles. A great body of geological evidence has now been brought together to show that this machinery for scattering plants, as well as for carrying erratic blocks southward, and polishing and grooving the floor of the ancient ocean, extended in the western hemisphere to lower latitudes than the White Mountains. When these last still constituted islands, in a sea chilled by the melting of floating ice, we may assume that they were covered entirely by a flora like that now

confined to the uppermost or treeless region of the mountains. As the continent grew by the slow upheaval of the land, and the islands gained in height, and the climate around their base grew milder, the arctic plants would retreat to higher and higher zones, and finally occupy an elevated area, which probably had been at first, or in the glacial period, always covered with perpetual snow. Meanwhile the newly-formed plains around the base of the mountain, to which northern species of plants could not spread, would be occupied by others migrating from the south, and perhaps by many trees, shrubs, and plants then first created, and remaining to this day peculiar to North America.—*Condensed from Lyell's Second Visit to the United States.*

PECULIARITIES OF FLOWERS.

We find, in the *Patent-Office Report* for 1848 (published about July, 1849), a translation of the results of some observations made by a German botanist on the growth of certain plants. His experiments were made with briony, pharcala, elder, and flax. "The growth of these plants advanced uninterruptedly by day and night; but, with the exception of the flax, the growth was more by day than by night. Further, the observations made on the briony the first day showed, that, with the increase of the heat of the sun, the growth of the outward portions of the plants fell off, and also in disturbed and rainy weather. Flax grows on an average more in the night than in the day, and more in troubled weather than in sunshine,—a proof that it requires for its success a moist atmosphere."

The same report also contains the results of the observations of another botanist, on the coloring of flowers. The coloring of flowers is intimately connected with the alternations of the seasons. "In considering the vegetables of our country (Germany), either in a mass or in groups, we see invariably that the number of flowers increases from December to July. White flowers are the most numerous during the whole period of the year when plants are seen in blossom; after these come the yellow, then the orange, the blue, the violet, the green, and, lastly, the indigo flowers, which are the most uncommon. The law according to which the increase of flowering takes place shows itself to be closely connected with the mean temperature; but from time to time anomalies are exhibited, which the change of temperature alone cannot explain; such is the rapid decrease of the number of flowering plants from the end of July to that of August. From the month of January, when all the flowers are white, to the vernal equinox, the relative number of white flowers rapidly decreases; after that period the proportion of them increases till the middle of May, and then insensibly diminishes till the time when the frosts arrest all vegetation. If we set aside the very small number of yellow flowers which appear in February and March, we see that the proportion of flowers of that color increases from the beginning of April to the end of June, then it remains stationary till the middle of August, after which it increases again till the frosts come. The proportional number of red flowers gradually diminishes from February to the end of April, then recovers the ascending scale

till the end of August, after which it decreases till October; it then rises again till November, when most of the cultivated flowers are of that color. The green or greenish flowers diminish in number from March till the end of May, and after this the proportion is about uniformly maintained till winter. Blue flowers increase to the middle of April, then decrease to the summer solstice, then ascend to the number reached in April, after which they rapidly decrease, and totally cease on the arrival of the frosts." The other colors are not regular enough to allow of the giving of a rule for them.

The author of these observations has arranged the increase and decrease of the colors in tables, to show them at a glance. It is then seen that each color rises twice and decreases twice. Whenever the white flowers increase, the yellow decrease, and *vice versâ*. The red and green always correspond, as do the blue and violet flowers. These laws apply to species, not to individuals.

The same botanist, M. Fritsch, has had the curiosity to examine the corolla of flowers. The number of plants opening their corolla during the night is very small, compared with that of those blossoming during the day, being only about 12 per cent.

PIASSABA.

PROFESSOR BALFOUR, at the meeting of the Botanical Society of Edinburgh, in Jan., gave an account of "Piassaba, a fibrous matter from South America, used for the manufacture of ropes, &c." He stated that the piassaba fibre belongs to the palm tribe, coming from the Cocos de Piaçabe of Prince Maximilian. This tree attains a height of 20 or 30 feet, and has pinnated fronds 15 or 20 feet long. The fibres of the leafstalks, after maceration, are used for making very tenacious cables, which resist well the action of salt water. The black fibrous matter, resembling whalebone, which is connected with the leaves, has been employed for forming brushes. The fruit of this palm is imported into this country, under the name of Coquilla nuts. The shell or covering of the nuts is used for making many small articles, such as handles for umbrellas, drawers, &c. When examined under the microscope, it exhibits thickened cells, very much resembling those seen in bone.

THE ACTION OF CARBONIC ACID ON PLANTS.

PROFESSOR DAUBENY has read before the British Association a report "On the Action of Carbonic Acid on Plants allied to the Fossil Remains found in the Coal Formation." The apparatus used in the experiments made by Prof. D. was so constructed, that a constant supply of carbonic acid could be kept up, so that plants or animals exposed in it were constantly subjected to the same quantities. The results of the experiments were, first, that quantities of carbonic acid not exceeding 5 per cent. did not appear to affect injuriously species of ferns or pelargonium; second, a quantity amounting to 20 per cent. injured plants exposed to it; third, the quantity of oxygen given out by plants was not found to be increased by the quantity of carbonic acid to which they were exposed; fourth, on exposing animals to the action of carbonic acid, it was found that frogs and many fish could

live in an atmosphere charged with 5 per cent. of carbonic acid. From these experiments, he concluded that no objection could be offered to the theory of a large proportion of carbonic acid having existed in the atmosphere in the early periods of the world's history.—*London Athenæum, Sept.*

NEW SUBSTITUTE FOR THE POTATO.

A VEGETABLE, called the *Oxalis crenata*, has been known to the scientific agriculturist of Europe for some years. It is a tuber, the culture of which, however, upon a large scale has been little practised. It is stated by the Baron Suarcé (who has cultivated about two acres and a half of it on his own estate in the South of France), to possess a larger degree of nutriment than most of the farinaceous plants that form the basis of human food in our climate. The total weight of the crop produced on two acres and a half, cultivated by him, was ten tons, from which three tons of flour were obtained. From the stems of the plant, which may be cut twice a year, and can be eaten as a salad or spinage, ninety gallons of a strong acid were obtained; which, when mixed with three times its bulk of water, is well adapted for drink. The acid, if fermented and brought to an equal degree of acidity with vinegar, is superior to the latter when used for curing or preserving meat, as it does not render it hard, nor communicate to it a bad flavor. The flour obtained from the *Oxalis crenata* is superior to that obtained from the potato, maize, or buckwheat, as it makes an excellent light bread when mixed in the proportion of one fourth with wheat-flour. This is not the case with the potato, maize, or buckwheat flour. The *Oxalis crenata* came originally from South America, and is a hardy plant, unaffected by change of temperature. It grows readily in almost any soil, and when once introduced it is difficult to eradicate it.—*Proc. of Society of Arts.*

CHINESE HEMP.

M. STIER, a member of the French embassy in China, a year or two since, procured some seeds of the Chinese hemp, which he transmitted to M. Garnier Savatier, who has succeeded in cultivating and naturalizing it in the vicinity of Marseilles, and has thus enriched France with a very important new production. This hemp grows to a height of twenty-four or twenty-five feet; the stalk is from five to six inches in circumference, and each plant produces from two to three kilograms* of seed, and furnishes thread enough to make a yard of superb lawn, superior in beauty and quality to any obtained from French materials. The cultivation of the plant in the South of France will be the more advantageous to the country, as a climate of the temperature of that region is necessary for bringing the seeds to maturity, and these will find a ready market in those countries where the seeds will not ripen, but where the filaments may be produced. Some specimens of this plant have been exhibited at a recent agricultural show at Montpellier. Would it not be well for some of our Kentucky hemp-growers to endeavour to introduce this new hemp into this country, as it would probably thrive at the South?

* A kilogram equals about 2lbs. 3oz. Avoirdupois.

RYE IN A WILD STATE.

M. de Candolle says, in an article in the *Bibliothèque Universelle de Genève*, that "both history and botany agree in rendering it probable that wheat, barley, rye, and oats came originally from Asia, especially from the western and central regions of that part of the world." He then cites the large number of botanists and travellers who have written upon this subject, but none of them have hitherto brought forward anything entirely conclusive. "But M. C. Koch, a traveller who has traversed Anatolia, Armenia, the Caucasus, and Crimea, now affirms that he has found rye under circumstances where it appears to be really spontaneous and native. On the mountains of Pont, not far from the village of Dshmil, in the country of Hemschin, upon granite, at an elevation of 5,000 or 6,000 feet, he found our common rye alongside the road. It was thin in the ear, and about 1 to 2½ inches long. No one remembered that it had ever been cultivated in the neighbourhood, and it was not even known as a cereal. The question appears thus to be decided in the way that history and botanical geography rendered most likely."

GUTTA-PERCHA.

This substance, which is rapidly coming into use, is, as all know, the gum or sap of a tree found in the Indian Archipelago. It has recently been found to be composed of three distinct substances, a white matter, which is considered the pure gutta-percha, a substance of a dark brown color, and a considerable quantity of sulphur. Various experiments have been made to ascertain its strength when mixed with other matters, and also to determine what pigments will mix with it, without rendering it brittle, or deteriorating its qualities. From these it appears that the only pigments to be entirely relied on are orange red, rose pink, red lead, vermilion, Dutch pink, yellow ochre, and orange chrome. Under the influence of heat and pressure, gutta-percha will spread to a certain extent, which is greater when it is mixed with foreign matters. All the mixtures of gutta-percha and other substances, except that containing plumbago, are found to increase its power of conducting heat, but in its pure state it is an excellent non-conductor of electricity. The best composition for increasing the pliability of gutta-percha is that formed with caoutchouc tar, and the next best is that with its own tar. The best material known for moulding and embodying is obtained by mingling gutta-percha with its own tar and lampblack. In the process of manufacture, the rude blocks of gutta-percha are first cut into slices, by means of a machine formed of a circular iron plate of five feet diameter, in which there are three radial slots, furnished with as many knives. The slices are then placed in a wooden tank containing hot water, in which they are left to soak till they become plastic. They are next passed through a mincing-cylinder, similar to that used in paper-mills for the conversion of rags into pulp, and then they are thoroughly cleansed in cold water tanks, the water, where the gutta-percha is impure, being mixed with

a solution of common soda, or chloride of lime. It is next put into a masticating machine, such as is used in the manufacture of caoutchouc, and is then pressed through rollers, which convert it into sheets of various widths and thicknesses. These sheets are subsequently cut into boards, by vertical knives placed at the further end of a table, along which the sheets are carried, by a cloth or web, to another roller, round which they pass, and are thus cut into the required sizes. All kinds of ornamental wainscoating and mouldings are now made of gutta-percha, in addition to the other innumerable uses to which it is daily applied.

BOTANICAL TREASURES OF CALIFORNIA.

THE following remarks on the flora of California are from the pen of W. R. Prince, the distinguished florist and botanist of Flushing, L. I.

"There are hundreds of species of trees, shrubs, herbaceous and bulbous flowering plants indigenous to California, which are totally distinct from those found in other parts of the globe, and many of them are entirely new to the botanic world. The most important of these are two new species of pines, and another of cedar, which attain each a diameter of eight to twelve feet, and which comprise dense forests of the finest timber in the world, between the extreme spurs and central range of the Sierra Nevada, and whose existence there in such masses is almost unknown, even to those settled in California.

"A railroad connecting these immense forests with the San Joaquin, or some navigable branch, would speedily render the aid of Oregon, as regards the supplies of timber, entirely nugatory. Of the oak (quercus), there are five species, three of which are timber-trees, and two shrubby and unavailable. The arbor vitæ, growing in the pine forest referred to, and forming a most regular and beautiful cone, is a distinct species, greatly assimilating to the *Thaya sibiriki* in foliage, and attaining to a height of eighty to one hundred feet. In other localities there were found two species of ash, one of alder, a myraca twenty feet high and two feet in diameter, a photinia of great beauty, fifteen feet high and two feet in diameter, several species of rhamnus, a species of crab-apple from which the Indians make cider, a species of the cercis or Judas-tree, a clematis, honeysuckle, symposia, and cephalanthus, with some species of grapes, two fine species of raspberries, two species of blackberries, several species of currants, a gooseberry, two varieties of the strawberry of a new and peculiar species, with a large and excellent fruit; a calycanthus attaining ten to twelve feet in height, with very large flowers, which continue their bloom through several months; a dwarf horsechestnut or buckeye, of fifteen feet in height, and spreading to an equal diameter, producing a profusion of beautiful flowers; and many other productions of equal interest, which time will not allow me to enumerate.

"In bulbous flowers this country is particularly rich, and many of them are of great beauty and interest, and particularly striking; the balsamic character of very many of the herbaceous plants forms a peculiar feature in that class. The chanchalagua, so celebrated for it

medicinal qualities, and of which bunches in a dry state are preserved in so many Indian huts, is found in considerable patches in the moist ravines through which streams occasionally flow from the mountain ranges. I have succeeded in collecting and preserving the seeds and bulbs of above one hundred species of plants and trees, which I shall transmit to the United States."

CURE FOR HYDROPHOBIA.

M. D'HERICOURT, who has recently returned from a long residence in Abyssinia, has brought home, among other valuable articles, numerous specimens of a plant, the root of which is a cure for hydrophobia, both in men and animals. When presenting specimens of this plant to the French Academy, on Nov. 12th, M. d'Hericourt says:—"In preparing this medicine, the bark of the root is slightly scraped, after which the root itself is dried and reduced to a powder. 10 or 12 grains are given to the patient in a spoonful of honey or milk. An hour or two after having taken this dose, and after he has had several discharges and vomitings, many cups of whey are given him, and when he is much weakened by the discharges, he is made to eat the gizzard of a fowl roasted in butter, and well spiced, which stops the effect of the medicine. The patient also eats the chicken, cooked in the same way, with a great deal of spice. It is probable that French physicians will do away with this portion of the treatment. This root, whose 'emetic cathartic' effects I have seen, acts also on the urine, in which I have found microscopic worms. A soldier and three dogs that had been bitten were treated by this root in my presence, and were cured, while a fourth dog, bitten at the same time, but not so treated, died.

"I have brought from Abyssinia the plant whose roots produce the remarkable effects mentioned; it grows in low and warm regions, in an 'argillaceous silicious' soil; its tap-root attains the length of more than a metre* with a diameter of two or three centimetres; its active property appears to reside under the epidermis. The head of the root is relatively very large, and produces numerous creeping stems, some of which are more than two metres long; the stem is square, slender, about three millimetres in diameter, and has a sort of prickly hair on it. The leaves, resembling those of the tribe *cucurbitacæa*, have five principal divisions, and are alternate, being placed opposite to tendrils, and three or four centimetres apart. The flowers are placed at the extremity of the ovary, and there are several of them upon the same stem. The fruit is oblong, smooth, of a greenish-yellow color, and when ripe is from three to four centimetres long."

EXISTENCE OF OVULES IN THE MALE OF PLANTS AND ANIMALS.

DR. CH. ROBIN, having submitted to the Paris Academy of Sciences a paper "On the existence of an ovum or ovule, as well in the male as in the female of plants and animals; producing in the one *case* pollen-grains, in the other the primitive cells of the embryo," a

* A metre equals about 39.37 inches.

committee, consisting of Serres, Dumas, and Milne-Edwards, was appointed to examine the subject of the paper. They have reported that "the facts contained in this memoir prove that, in the male organ of plants and of animals, an ovule is formed, analogous to that of the females, and constituted in a like manner; that the vitellus (the bag interposed between the embryo and the albumen) divides, as does that of the female, and by the same mechanism, giving rise to the embryonary cells, which, after being modified by a special evolution, constitute pollen-grains. Thus, there is an analogy, and often an identity, between the product of the male generative organs and that of the female. On the other hand, there is an identity in the mode of formation of the embryonary cells in the ovum of vegetables and of animals; and lastly, the mechanism by which the embryonary cells of the male ovule are formed is the same as that which forms the primary cells of the female ovum. Thus the phenomena of the division of the vitellus, described among the vertebrata by Dumas, may be extended to vegetables in an equal degree."

THE TEA CULTURE IN THE UNITED STATES.

Dr. Junius Smith has lately commenced the culture of the tea-plant in the United States, with a view of deciding whether it can be advantageously cultivated in this country. Others have often tried the experiment by planting the seeds, but Dr. Smith has procured from China a large number of plants of seven years' growth, which, at the last accounts, were in full blossom. He selected Greenville, in South Carolina, as the place where he would try the experiment, and in the latter part of December, 1848, he set out his plants, five hundred in number, all but five of which were perfectly healthy and vigorous. In a pamphlet on this subject, published by Dr. Smith, he states that in China the tea-plant grows most luxuriantly between the parallels of 20° and 45° north latitude. In the United States, he thinks that we may assume the latitude of 40° as the northern, and the Gulf of Mexico as the southern limits of the tea-growing districts. This would include Delaware, Maryland, Kentucky, and Virginia, parts of Ohio, Indiana, Pennsylvania, and Missouri, and all the States south of these. The northern portion of Newcastle county, in Delaware, is in the same parallel as Pekin, one of the finest tea-growing districts in China. The annual consumption of tea in this country is about 11,000,000 pounds, and, upon the supposition that the average product of an acre of land is 547 pounds, it will require the cultivation of 20,109 acres to supply the present consumption, without allowing for the large annual increase. It is well known that the tea-plant has been introduced into Brazil with considerable success. Should Dr. Smith succeed in his laudable enterprise, we may hope in a few years to have tea of a flavor never before tasted in this country. It is a notorious fact, that all tea loses by being kept, and the finest kinds will not at all bear to be transported across the ocean. The reason why the tea used in Russia is so far superior to that of any other country, except China, is, that it is transported over land by means of large caravans.

GREEN TEA,—HOW COLORED.

A FOREIGN correspondent of the *London Athenæum*, of Aug. 4, furnishes the following information concerning the mode of coloring green teas as practised by the Chinese in the celebrated tea-growing district of Wheychow. The writer, accompanied by an excellent interpreter, was favored with an opportunity of witnessing the whole process, the details of which were noted down with great care.

The superintendent of the tea-makers managed the coloring part of the business himself. In the first place, he procured a portion of indigo, which he threw into a porcelain bowl not unlike a chemist's mortar, and crushed it to a fine powder. He then burned a quantity of gypsum in the charcoal fires which were roasting the tea. The object of this was to soften the gypsum, in order that it might easily be pounded into a fine powder, in the same manner as the indigo had been. When taken from the fire it readily crumbled down, and was reduced to a powder in the mortar. These two substances, having been thus prepared, were mixed up in the proportion of four parts of gypsum to three of indigo, and together formed a light blue powder, which in this state was ready for use. This coloring matter was applied to the tea during the last process of roasting. The Chinese manufacturer having no watch to guide him uses a joss stick to regulate his movements in regard to time. He knows exactly how long the joss stick burns, and it of course answers the purpose of a watch. About five minutes before the tea was taken out of the pans the superintendent took a small porcelain spoon and lifted out a portion of the coloring matter from the basin, and scattered it over the tea in the first pan; he then did the same with the rest, and the workmen turned the leaves rapidly round with their hands in order that the color might be well diffused. During this operation the hands of the men at the pans became quite blue.

The writer took some trouble to ascertain precisely the quantity of coloring matter used in the process of dyeing green teas, and he found that to 14½ pounds of tea rather more than an ounce of this indigo and gypsum mixture was applied. So that for every hundred pounds of green tea, which are consumed in England or America, the consumer really introduces into his stomach more than half a pound of this deleterious dye, which there is little doubt often has Prussian blue substituted in it for the indigo.

In five minutes from the time that the coloring substance was thrown into the pans the desired effect was produced. Before the tea was removed, however, the superintendent took a tray and placed a handful from each pan upon it, and these he examined to see if they were uniform in color, and if the examination was satisfactory he gave the order to remove the tea from the pans, as the process was complete. But sometimes it happened that there was a slight difference in the color of the samples, and in this case it was necessary to add more dye, and therefore to keep the tea a little longer in the pan.

On being asked their reasons for thus dyeing their teas, the China-

men quietly answered, that foreigners always paid a higher price for such teas, and that the manufacturer had no objection to supplying them with it.

CHICCORY-COFFEE.

THE manufacture of a factitious coffee from the roasted root of chiccory appears to have originated in Holland, where it has been practised for more than a century. It remained a secret until 1801, when it was introduced into France. The manufacture of chiccory-coffee in this latter country was for a long time of but little importance, but within a comparatively few years it has extended considerably and become an object of commerce of great value; in fact, 12,000,000lbs. are consumed in France, and a large quantity is also yearly exported. Numerous manufactories have also been started in England, which receive their supplies of dry chiccory from the Continent, and to some extent from Ireland.

The chiccory-plant requires a deep soil of good quality, and well prepared; the seed is sown in May, and the harvest takes place in October. Some time before collecting the roots, the leaves are mowed, and cows fed with them. They form a most excellent fodder, but when given alone communicate a very disagreeable flavor to the milk of the animals. The roots are dug with a spade, placed in heaps and covered with straw to preserve them from the frost until ready for use. They are afterwards thoroughly dried by a furnace, and cut into strips, in which state they are sold to the manufacturers, who roast them according to the demand. When the roasting, which takes place in large cylinders, is nearly complete, two per cent. of butter is added, in order to impart a lustre to the chiccory. The substance is then ground in a mill, sifted, and a small quantity of reddish coloring material is added to give it the appearance of coffee. The product is then weighed off, and sold in packets under a variety of names, but rarely under its own; for instance, among others, Mocha powder, ladies' coffee, Chinese coffee, pectoral coffee, colonial coffee, &c. In Holland this chiccory is mixed with coffee in variable proportions; the resulting product is very bitter, and is considered by the common people to be a very salutary refreshment, which modifies the stimulant action of the coffee. Such a favorable idea has been formed of it, that of late the chiccory has been employed alone, without any addition of coffee; and yet it possesses no other virtue than that of coloring the water in which it is boiled or infused, of communicating to the liquid the bitter taste of the extractive substances contained in the chiccory, and of being far less expensive than coffee. The chiccory, notwithstanding, is frequently adulterated with brick-dust, roasted bread, acorns, corn, beet-roots, and carrots.—*Condensed from the London Chemical Gazette.*

SACCHARINE RICHNESS OF THE SUGAR-CANE.

M. CASASECAS has communicated to the Paris Academy the result of some important investigations on sugar-cane. One of the facts

which he has ascertained is, that the sugar is in greater quantity in the foot than in the rest of the cane; it diminishes throughout the first third of the length; but if the mean term of the central third, and that of the higher, be taken, there result nearly equal quantities of sugar: it follows, that, from the beginning of the central third up to the top of the vegetable, the distribution of sugar is almost uniform. The quantity of sugar in the central third is very nearly the mean term of the total contained in the cane; to determine, therefore, the value of a cane, it is enough to analyze the central third of its length. If the prescribed rules be observed with some care, the planter, who knows how to weigh, dry, and boil the cane, with distilled water, or water condensed in the mill steam-engine, may, by simple calculations, confined to multiplications and to divisions of decimal numbers, always ascertain the mean saccharine richness of his cane.

GRAPE CULTURE IN THE VICINITY OF CINCINNATI.

In the vicinity of Cincinnati the culture of grapes, for the purpose of making wine, is carried on to a considerable extent, and, as in some other portions of our country, is increasing every year. A hill-side with a southern aspect is selected, if possible, and the ground is laid off into rows 3 feet by 6. The avenues should be 10 feet wide, dividing the vineyard into squares of 120 feet. Two cuttings are usually planted at each stake, but only one is allowed to grow, and the time of planting is the end of March, provided the cuttings have been previously buried in the earth for a time, so as to swell the buds. The first year after planting, the vine is usually cut down to a single bud, but the third year three or four are left. When the grapes are very ripe, the unsound ones are carefully picked off, after which the bunches are washed in a tub, or passed through a small mill, breaking the skin, but not the seed, and then they are thrown into the press, and the screw applied till they are pressed dry. For fermentation the juice is put into clean casks in a cool cellar, and the casks filled within about four or five inches of the bung, which is put on loosely. The gas escapes, but the wine does not run over, and in from two to four weeks the fermentation ceases, and the wine clears. In February or March the wine is racked off into clear casks, and a moderate fermentation again occurs, after which the wine fines itself, and is ready for bottling or barrelling. The cost of a vineyard of six acres, with 14,400 vines, is, at the most, $1,800. By the third year the vines generally produce enough grapes to more than pay the expenses of that year, and after that, for eight or ten years, the net profit per annum is $1,050, at one dollar per gallon for the wine. To attain this the vineyard must be well situated, and free from the rot. It is estimated that over 300 acres are now planted with the vine within a circuit of twelve miles round Cincinnati, nearly two thirds of which were in bearing in 1848, producing, notwithstanding the prevalence of the rot, from 50,000 to 60,000 gallons of wine. The Catawba is the most cultivated, and the Cape next, while the Isabella is raised only for table use. A bushel of grapes, if well ripened, will produce from three and a half to four gallons of wine.—*Condensed from the Patent-Office Report.*

ZOÖLOGY.

NUMBER OF VERTEBRATE, MOLLUSCOUS, ARTICULATED, AND RADIATED ANIMALS.

The number of vertebrated animals may be estimated at 20,000. About 1,500 species of mammals are pretty precisely known, and the number may probably be carried to about 2,000.

The number of birds well known is 4,000 or 5,000 species, and the probable number is 6,000.

The reptiles number about the same as the mammals,—1,500 described species,—and they will probably reach the number of 2,000.

The fishes are more numerous; there are from 5,000 to 6,000 species in the museums of Europe, and the number may probably amount to 8,000 or 10,000.

The number of mollusks already in collections probably reaches 8,000 or 10,000. There are collections of marine shells, bivalve and univalve, which amount to 5,000 or 7,000; and collections of land and fluviatile shells, which count as many as 2,000. The total number of mollusks would, therefore, probably exceed 15,000 species.

Among the articulated animals it is difficult to estimate the number of species. There are collections of coleopterous insects which number 20,000 to 25,000 species; and it is quite probable, that, by uniting the principal collections of insects, 60,000 or 80,000 species might now be counted; for the whole department of Articulata, comprising the Crustacea, the Cirrhipeda, the insects, the red-blooded worms, the intestinal worms, and the Infusoria, as far as they belong to this department, the number would already amount to 100,000; and we might safely compute the probable number of species actually existing at double that sum.

Add to these about 10,000 for Radiata, Echini, star-fishes, Medusæ, and Polypi, and we have about 250,000 species of living animals; and supposing the number of fossil species to equal them, we have, at a very moderate computation, half a million of species.—*Principles of Zoölogy, by Agassiz and Gould*, Part I.

CAUSE OF PHOSPHORESCENCE IN THE OCEAN.

We derive the following from a paper read before the British Association by Dr. J. H. Pring, entitled "Observations and Experiments on the *Noctiluca miliaris*, the Animalcular Source of the Phosphorescence of the British Seas."

After glancing at the theories which have been proposed to explain the phosphorescence of the ocean, and mentioning some remarkable exhibitions of this phenomena, Dr. P. remarks, that there now "appears little doubt that the power of phosphorescence is actually possessed by animals ranking as high as the class of fishes." The general phosphorescence of the ocean is chiefly due to the numerous kinds of Medusæ, Polypiferæ, Rotiferæ, and Infusoria, included under the class Acalephæ, but it is particularly owing to the microscopic *Noctiluca miliaris*. Having taken a bucket of water from the sea, Dr. Pring kept it over night, and on the following morning "innumerable very minute gelatinous bodies, of a globular form, could be perceived even with the naked eye, floating near the surface of the water." From repeated observations, it is clear that these little animals are either naturally specifically lighter than sea-water, or possess the power of rendering themselves so; this property appears to be a living attribute, since it ceases at death. When examined by the microscope, nothing is seen that indicates any special luminous organ, but in several specimens a mass of loose flocculent mucus was observed adhering near the insertion of the tentaculum, "so that I am disposed to believe that the phosphorescent principle resides in this mucus, and is probably most vivid at the moment of its secretion, the secretion itself being influenced and thrown out more abundantly under circumstances indicating danger." The natural size of the animal is stated not to exceed the thousandth of an inch in diameter.

Dr. Pring performed some interesting experiments on this animal, but we can only detail a few of them. Subjected to a simple galvanic current from two of Smee's batteries, no very perceptible effect could be observed. By passing the electro-magnetic current through the water, after a considerable time a steady and continued glow of light was given out from the whole of the water, the surface of which appeared as if spangled with numberless minute but persistent points of light. The light ceased after a quarter of an hour, and could not be reproduced, owing evidently to the death of the animalcules.

When a portion of the luminous sea-water was placed in a bottle filled with oxygen gas, the phosphorescence of the animals was increased whenever the water was agitated with the oxygen. The animals lived in this state for more than a week. With nitrogen the effect was similar, but the brilliancy of the light was somewhat less. Sulphuretted hydrogen gas instantly destroyed all the luminosity, being at once fatal to the animals. With carbonic acid gas the luminous property of the water was not only brought out and highly increased, but was rendered permanent for at least fifteen minutes, the light being bright enough to enable one to see the hands of a

watch in a dark room. At the expiration of about fifteen minutes the light became gradually fainter, and in five or ten minutes more had totally ceased.

When sulphuric acid was dropped upon the water, it emitted for a minute or two a bright light, and then disappeared. Nitric acid had the same effect, and with hydrochloric acid the increased luminosity was much less conspicuous, and the darkness ensued almost instantaneously. A few drops of ether let fall into the sea-water in the dark appeared instantly to deprive it of its luminous property. On substituting chloroform for ether, in a second experiment, a very bright and persistent phosphorescence was given out for a few minutes, after which the water speedily became dark, the animalcules being evidently destroyed.

FRESH-WATER COTTUS OF NORTH AMERICA.

AMONG the papers presented to the American Association, in relation to the ichthyology of this country, we would mention a Monograph of the Fresh-water Cottus of North America, by Charles Girard, Esq., Cambridge, Mass. The investigations into which the author has been led have shown that the *C. gobio* is not an inhabitant of our country, as has hitherto been supposed, and that several other new species of cottus exist in different hydrographic basins.

NEW GENUS OF FISHES.

THE *Boston Journal of Natural History*, Vol. VI. No. I., contains a description of a new genus of fishes, established by Mr. W. O. Ayres, of Boston, Mass. The specimen from which the description is drawn was picked up at sea, in N. lat. 42°, and W. Long, 50°, in the month of June, 1848. It was alive when taken, and was floating in a vertical position, with a snout a little above the surface of the water. It differs so widely from every established genus, that even its place in the system becomes a matter of question. "It is therefore necessary," says Mr. Ayres, "to form for its reception a new genus, for which I propose the name *Malacosteous*, and which may be thus characterized :—

"Mouth extremely deep cleft : border of the upper jaw formed principally by the maxillary, the intermaxillary being short. Teeth in the upper jaw small, separate, and sharp-pointed, on both maxillary and intermaxillary. Teeth in the lower jaw very long, separate, somewhat hooked, followed by others much smaller and closer together. No teeth on the palatines, vomer, or branchial arches. A double row on the tongue. A single dorsal fin near the tail, opposite the anal. Whole fish entirely destitute of scales. All of the bones remarkably soft. Opercular pieces consisting of a membrane without ossification. Branchial rays not discernible. The species, from its color, may receive the name *Malacosteus niger*."

The length of the fish is eight and one half inches, with a body nearly cylindrical. One of its most striking peculiarities is, that the entire osseous system is in a very low state of development. All of

the bones are quite soft, and from this fact its generic name is derived. Through the vertebræ even a needle can be passed without difficulty, the resistance being about the same as in piercing cartilage, while many of the bones are entirely wanting, and their places merely indicated. Of the habits of this fish we know nothing. It belongs to deep water, and is of slow motion. To no family does it appear to approach so nearly as to the Salmonidæ.

NEW FISHES FROM LAKE SUPERIOR.

Prof. Agassiz gave an account of two new fishes obtained by him at Lake Superior, which he regarded as types of two new genera. The first is an entirely new type in the class of fishes. It is a small fish, five or six inches long, which, in some respects, resembles several families, but is most like the Percoids, though distinct from them. Fossil species with similar characters are found in the cretaceous formations. This is the second, Prof. A. remarked, of the "old-fashioned" fishes, so to speak, corresponding in their structure to a fossil species, which has been observed in this country. The other fish is the only living representative of a large family of fossil species. The existence of these two species has undoubtedly reference to the fact, that America is the oldest extensive continent which has been upheaved above the level of the sea. In New Holland, two genera exist bearing similar relations to older families, a fish and a shell, which have their analogues among the oölitic deposits.—*Proc. Boston Nat. Hist. Society.*

NOTICE OF A RIBBON-FISH TAKEN OFF THE COAST OF NORTHUMBERLAND.

On the 26th of March, a fine specimen of the *Gymnetrus* or ribbon-fish was captured off the coast of Northumberland, England, by the crew of a fishing-boat. The animal was seen floating on the water, nearly dead; and when opened it was found to have swallowed a piece of zinc, which had evidently been the cause of its weak condition. These fish apparently live on the ground in the deep sea; and the smallness of their mouths, which does not permit their taking ordinary bait, will account for their being so seldom seen.

It is described, by those who saw it a few hours after its capture, as being of a uniform silvery-gray color, with a few black spots towards the anterior part of the body. It presents somewhat the form of a double-edged sword-blade, being excessively compressed; the length is 12 feet 3 inches, the mouth not being projected forward, and directly behind the gills it is 8½ inches deep; 2 feet farther back it attains its greatest depth of 11¼ inches. The thickness through the head is 2 inches. When first taken it was of a brilliant iridescent hue, but this soon faded away. No scales are visible to the naked eye, but they are easily detected with a microscope. Four flattened ridges, each more than an inch broad, extend from the head to the tail. The head is small and short, measuring only 9

inches, and the mouth is also small and of a circular form. The eye is about 1½ inch in diameter, and the iris is of a beautiful silvery white. The tongue is prominent, but small, smooth, and fixed, and there are no teeth.

Only seven or eight species of the *Gymnetrus* have been recorded, and this specimen is believed to belong to one described by Cuvier, from a specimen which was thrown upon the English coast, and examined by Sir Joseph Banks. It is believed that, though this fish is very rare, specimens of it have been from time to time captured and exhibited, but till now it has never been brought to notice and scientifically described.—*Condensed from the Mag. of Nat. Hist., July.*

DISCOVERY OF CORAL ANIMALS ON THE COAST OF MASSACHUSETTS.

Prof. Agassiz, while on an expedition in one of the vessels of the Coast Survey during the past summer, obtained by means of a dredge, from a depth of seventy-two feet, in the Vineyard Sound off Gay Head, several specimens of a coral with its animals. By great care and attention, they were preserved alive in glass jars for more than six weeks, and afforded an excellent opportunity for an examination and observation of their structure and habits. These corals belong to the genus *Astrangia*, and have been named by Prof. Agassiz, in honor of Prof. Dana, geologist of the Exploring Expedition, *Astrangia Dana.*

This species presents two varieties. Some are of a pink or rose color, others are white. The general form of the animal is a cylinder (as of all the Polypi), resting on its base, and expanded on the upper margin. Thus expanded, it is about two lines in diameter. The number of tentacles is definite, but it is not always the same absolute number. It never exceeds twenty-four; in the earlier periods of life there are only twelve, and there is even an epoch when there are only six.

It is perhaps a matter of surprise that the coral animal should have been found in this latitude. They teem in the warm latitudes; but there are very few species in the more temperate regions, and but for the opportunity afforded by the Coast Survey, the existence of these animals could not have been suspected on these shores. For many years, however, dead fragments had been found along the shores; but whether they lived there naturally or not, had not been ascertained.

STRUCTURE OF THE CORAL ANIMALS.

The following description of the coral animals found on the coast of Massachusetts by Prof. Agassiz was presented by him at the meeting of the American Association:—"We have, below the mouth, a small cavity, which is shut by the contraction of the walls, and which, immediately below, expands into a wider

The upper cavity is the stomach. In the centre of it is a large opening, which communicates with the cavity below; so that the stomach, by the relaxation of its walls, that is, of its muscular fibres, throws down its own contents into the general cavity of the body. But during the process of digestion, when food has been introduced into this cavity, the mouth is shut, and the stomach is equally shut below. During the whole time that digestion goes on, the stomach remains as a closed bag; but, as soon as the food has been fully digested, then the lower cavity opens to empty its contents into the general cavity; but sometimes the upper opening expands first, and the refuse of hard particles is thrown away. The lower opening of the stomach is shut again as soon as the homogeneous mass of the digested food has entered into the wide cavity below, precisely as in Actinia.

"The hard parts of the Polypi are formed by means of cells, within the thickness of the walls of the animal itself. They are neither an external secretion, nor an internal skeleton, but constitute a calcareous deposit within the soft parts of the animal. It is by the accumulation of microscopic granules of limestone that a regular wall of stone is produced, within the thickness of the membranes, at their lowest portions. The tentacles of these animals are hollow, having vibrating cilia on their inner surfaces, by which very minute particles of food are brought to their mouth. Besides these cilia on the external surface, there are other organs which have been known to exist in other animals, but which have never before been observed in corals, called nettling organs. It is very well known that the jellyfishes, if handled, leave a painful sensation like that of the burning of nettles. It has been ascertained that this nettling arises from the action of a peculiar apparatus, about the form of slender thread issuing from a bulb. Now, in this coral animal, the whole surface of the tentacle is provided with such nettling apparatus, forming heaps, arranged over the surface like warts, nearly in rows. There are hundreds of these warts upon one of these tentacles, and if we examine their structure, we shall find that every one of them consists of nettling cells. The whole structure of these cells can scarcely be seen by the best microscopes now at our disposal. Even some of the microscopes, considered among the best, do not reach the limits which are required for such investigations. These heaps of wart-like bodies are accumulations of peculiar cells, and there is in each of them a thread coiled up in a spiral form. In some of these there is a sort of arrow, with the thread coiled up around the arrow. In others we have a conical-shaped cell, and here also a thread coiled up. Upon watching these cells, which, from their contents, I could have no doubt were the nettling cells, I have been fortunate enough to see the manner in which these threads are issued, like a lasso. I have no doubt that it is with this apparatus that they sting, though I cannot say what is the action produced upon the tissues of other animals to cause the painful sensations they produce, as all this apparatus is too minute to be investigated in any other way than through high powers of the microscope, with transmitted light, and the chemical operation of the fluid to produce such a sensation upon the skin cannot be dis-

cerned. The quickness with which these animals kill others which come in their vicinity, leaves no doubt that these little microscopic cells, with these threads, are most powerful weapons, by which they attack and kill their prey almost instantly.

"How does this thread, which is so long, uncoil and come out from the cavity of the cell? It is as quick as lightning, and therefore the more difficult to observe, as the whole thread, which is twelve or sixteen times longer than the longitudinal diameter of the original cell, is thrown out in almost an instant. It is here that I reach the extreme limits of the working power of our microscopes. In observing the cells, three times in succession, I saw the thread thrust out, at first appearing to turn with great rapidity upon itself within, and then, after a part had been pressed out, the extremity of the thread within came in sight and could be traced as it escaped through the whole length of the part already drawn out, until the whole was extended and the point actually projected outwards; so that this fine thread is in fact a tube, and is finally turned inside out to the very extremity of the thread. Now, conceive what extraordinary structure this apparatus must have to allow of such a motion! Our microscopes now do not reach at all the limits which they should reach in order to enable us to trace the structure by which such phenomena are produced. I only describe appearances now; but it is evident that an apparatus subservient to such a purpose, and acting with such rapidity, cannot but be highly complicated in its structure, although that structure is so minute as to escape the eye, even when armed with most powerful magnifying apparatus.

"Having described the peculiar form of the nettling cells of this coral-building animal, let me say what I have further seen about it. The festooned head of a tentacle, which is hemispherical, may send out from its termination thousands of these lassos at once, so that the summit of the tentacle is then like a formidable wall of peaks standing out in all directions, and between them all are vibrating cells with their myriads of cilia maintaining currents of water, the threads standing out from the empty capsules. It is impossible to give a description vivid enough to convey the idea of such an apparatus as this presents when sent forth against its prey. But it can readily be imagined how formidable such a contrivance must be, when these animals can reach out so far beyond their apparent surface and stretch forth these unseen organs of apprehension. These animals are, it will be perceived, most dangerous enemies to the small living beings around them, since the radius of their reach is so far beyond their apparent surface, owing to the length of their lassos."

THE SEA-COW.

At a late meeting of the Boston Natural History Society, the President, Dr. John C. Warren, introduced a subject of particular interest to those who have paid any attention to the study of the animals which are found on the shores of the United States.

It has long been known, that a large marine animal occurs about

the coast of Florida, where it is known under the name of Sea-cow but naturalists have not been in possession of precise information upon the character, form, and relations of this singular creature. That it is related to the sea-cow of the large rivers of South America, appeared evident from the reports circulated about it; and Dr. Harlan, of Philadelphia, had, even many years since, described portions of its skull as indicating a distinct species of the genus Manatus. But from the deficiency of materials upon which his description rests, so much doubt remained in the minds of critical zoölogists, as to leave it uncertain whether that species is really distinct from the one which has been found in the South American rivers, and which was first correctly described and figured by Alexander von Humboldt. The fragments preserved in the museum of the Academy of Natural Sciences in Philadelphia, and an imperfect skeleton, with isolated vertebræ, belonging to the Medical College of Charleston, S. C., where the only relics of that animal which were in the possession of naturalists up to this day, when Dr. Warren presented to the Society an almost perfect skeleton of this animal, and a well-stuffed skin, leaving no doubt as to its natural affinities among the herbivorous Cetacea, and showing plainly that the species inhabiting the southern coast of North America is quite distinct from that which occurs in the Amazon.

The specimen presented to the Society is about the size of a black-fish. It is remarkable for the width of the middle region of its body, and its broad, rounded tail, which contrasts, in a striking manner, with the small head, and the two little paddles on the sides of the chest. This rare specimen will not only be a precious addition and ornament to the museum of the Society, but will also afford an unexpected opportunity to describe more fully, and characterize and illustrate by figures, an animal which lives so near us, belonging to one of the most interesting families of the animal kingdom, and about which so little has been known up to the present day.

Prof. Agassiz thinks that the Manati have been improperly considered cetaceans; they differ from them in the form of the skull, which is elongated, and in the position of the nostrils, which are in front. On the other hand, the skull resembles that of the elephant, in front (particularly when seen from above), in some of the details of the facial bones, which are not like those of the Cetacea, in the palatine bones, the arrangement of the teeth, and in the curve of the lower jaw. Prof. Agassiz believed this to be the true embryonic type of the Pachydermata.

DISTRIBUTION OF ANIMAL LIFE ON THE SHOALS OF NANTUCKET.

Mr. Desor addressed the Society upon the subject of the distribution of animal life among the shoals of Nantucket. The shoals off Sancati Head, he said, might be regarded as a vast submarine plateau, with a depth of water upon it at no place greater than twenty-five fathoms. Its surface rises into four principal ridges, which approach the surface of the water at different places, to within fifteen, ten, six feet, or even one foot. The varying depth of water between

these ridges gives rise to four principal horizontal divisions, marked by the absence or the distinct characters of animal forms. The first division includes the top of these ridges, and extends horizontally to various distances, according to the configuration of the shoal. It is composed of sand, mostly quartzose, containing very little feldspar, with some grains of hornblende very much worn, but no animals. This sand, although very fine, is remarkable for its almost stony hardness. It has been a question to what this should be attributed. Some have thought that it may be owing to a cement combining with it, but on being dried it is found to lose its compactness. Lieut. Davis thinks that it is produced by the hammering action of the waves. From the second division, which is directly below this, the dredge brings up nothing but broken shells, exhibiting marks of the powerful action of the sea. This division extends to a vertical depth of from three to five fathoms. The third division, next below the second, contains pebbles and a few barnacles. The fourth division, at the bottom of the interval between the ridges, abounds in animal forms Every stone is entirely covered with corals or barnacles. It is worth remarking, that the species here existing are not peculiar to this place, but are found under other conditions nearer the surface of the water. Mr. Desor mentioned several species, which on the shoals are found at a depth of from ten to twenty-five fathoms, but in other places are found in very shallow water. These facts are at variance with the opinion of some, that each marine species has its district at a fixed depth below the surface. It may be true of some, however, which are found in brackish or fresh water. The pressure of the water prevents the existence of animals at a very great depth, while the beating of the waves, on the other hand, limits their range upwards. On Nantucket Shoals, this is very powerful, and is supposed by Lieut. Davis to be felt to the depth of perhaps ten fathoms. In sheltered harbours, species which on the shoals are compelled to live at the bottom of the trenches can find protection at the depth of a few feet. The fact, that specimens obtained from the deepest water on the shoals are entirely covered with delicate corals, proves the entire quietness of the water.—*Proc. of the Boston Nat. Hist. Society.*

ON THE ENGE-ENA, FROM GABOON, AFRICA.

WITHIN a few years past, evidence of the most satisfactory nature has been obtained by naturalists and others, showing that there exists upon the banks of the Gaboon River, Africa, a second and gigantic native species of man-like ape, superior in strength and size to the orang-outang. In 1847, four crania, two males and two females, a large portion of a male skeleton, and the pelvis of a female, were brought to the United States. These were the first remains of this animal which had been noticed by naturalists, and were described by Dr. Jeffries Wyman, in a paper read to the Boston Society of Natural History. Three other crania were afterwards sent to England, and described by Prof. Owen. Quite recently, some additional remains have been brought to this country, by Dr. George A. Perkins, late missionary at Cape Palmas, Western Africa.

This animal, to which the name Engé-ena has been applied, is by far the largest of all the African Quadrumana. The dimensions of the crania, compared with that of the chimpanzée, and a well-marked negro head, will be seen from the following measurements taken by Dr. Wyman:—

Greatest length of the head of the engé-ena, 11.4; of the chimpanzée, 8.0; of the negro, 9.6.

Greatest breadth across the post-auditory ridges of the engé-ena, 6.10; of the chimpanzée, 5.0; of the negro, 5.4.

Greatest diameter of the face across the zygomatic arches of the engé-ena, 7.0; of the chimpanzée, 5.0; of the negro, 5.7.

While the proportions of the humerus and the ulna are more nearly human in the engé-ena than in the chimpanzée, those of the humerus and the femur recede much farther from the human proportions than they do in the chimpanzée, as will be seen by the following measurements:—

Humerus of man, 15.0; of chimpanzée, 10.9; of engé-ena, 17.0; femur of man, 18.5; of chimpanzée, 11.0; of engé-ena, 14.0.

Thus in man the femur is three inches longer than the humerus; in the chimpanzée, these bones are nearly of the same length; and in the engé-ena the humerus is three inches longer than the femur,—indicating, on the part of the engé-ena, a less perfect adaptation to locomotion, in the erect position, than in the chimpanzée.

Prof. Owen, from an examination of the bones of the engé-ena in his possession, considers that it approached nearer to man than the chimpanzée, and is induced to regard it as "the most anthropoid of the known brutes." Dr. Wyman, however, after a careful investigation of a great number of crania, and other portions of the skeleton which have not been inspected by Prof. Owen, has arrived at an opposite conclusion, and thinks that, after placing side by side the different anatomical peculiarities of the two species, there is no alternative but to regard the chimpanzée as holding the highest place in the brute creation.

With the knowledge of the anthropoid animals of Asia and Africa which now exists, derived from the critical examinations, by various observers, of their osteology, their dentition, and the comparative size of their brains, it becomes quite easy to measure, with an approximation to accuracy, the hiatus which separates them from the lowest of the human race. The existence of four hands, instead of two, the inability to stand erect, consequent on the structure of a skeleton adapted almost exclusively to an arboreal life, the excessive length of the arms, the comparatively short and permanently flexed legs, the protruding face, the position of the occipital condyles in the posterior third of the base of the skull, and the consequent preponderance of the head forwards, the largely developed canine teeth, the laryngeal pouches, the elongated pelvis, the long and straight spinous processes of the neck,—these, and many other subordinate characters, are peculiarities of the anthropoid animals, and constitute a wide gap between them and the most degraded of the human races, so wide that the greatest difference between the latter and the noblest specimen of a Cau-

casian is inconsiderable in comparison. An examination of the capacity of the crania of engé-ena, chimpanzée, and of the different varieties of the human race, shows still more conclusively, that the highest animal does not approach very near the lowest man, but is separated by an impassable phrenological chasm. Dr. Wyman found the cranial capacity of four skulls, three males and one female, of the engé-ena to be, for the highest 34.5 cubic inches, the lowest female, 25 cubic inches; average, 28.95 cubic inches.

In three specimens of the chimpanzée,—all females, he found the highest cranial capacity 26 inches, the lowest 22,—average, 24. The following is a table of the results of examinations of human skulls, of various races, prepared by Dr. S. G. Morton, of Philadelphia:—

RACES.	No. of skulls measured.	Largest capacity.	Smallest capacity.	Mean.	Mean.
CAUCASIANS.					
Germans,	18	144	70	90	92
English,	5	105	91	96	
Anglo-Americans,	7	97	82	90	
MALAY GROUP.					
Malayan family,	20	97	68	86	85
Polynesian family,	3	84	82	83	
AMERICAN GROUP.					
Toltecan family,					
Peruvians,	155	101	58	75	79
Mexicans,	22	92	67	79	
Barbarous Tribes,	161	104	70	84	
NEGRO GROUP.					
Native African family,	62	99	65	83	
Hottentots,	3	83	68	75	
Australians,	8	83	63	75	

These results are derived from a table which Dr. Morton has based upon the actual measurements of over 600 skulls. The smallest mean capacity is that derived from the Hottentots and Australians, which equals only 75 cubic inches, while that of the Teutonic races amounts to 92 cubic inches. The maximum capacity of the engé-ena is, therefore, considerably less than one half the mean of the Hottentots and Australians, who give us the minimum average for the human races.

Dr. Savage, a resident on the Gaboon River, describes the engé-ena as an animal of great ferocity and strength, and much dreaded by the natives. It is seen, however, but rarely. The following note, accompanying two crania brought to the United States, was received from Dr. Perkins by Dr. Wyman:—"The two crania were received from a person on board a vessel trading in the Gaboon and Danger Rivers, Western Africa. They were obtained from natives on the banks of the latter, by whom they were preserved as trophies. From the gentleman who gave them to me, I learned that the killing of one of these animals was by no means a common occurrence. He describes the animal as being remarkably ferocious, even attacking the natives when found alone in the forest, and in one instance, which fell under his observation, horribly mutilating a man who was out in the woods felling trees to burn. His shouts brought to his aid several other natives, who, after a severe contest, succeeded in killing the engé-ena. The man was afterwards in the habit of exhibiting him-

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self to foreigners who visited the river, and of receiving charity from them."

Prof. Owen designates this new species of anthropoid animal, as the "Great Chimpanzee." The Mipongwes (natives inhabiting the banks of the Gaboon) call it the Engé-ena, a name considered by Dr. Wyman as more appropriate, since the term Chimpanzee has always been associated with the black or smaller species.—*Compiled from a paper furnished by Dr. Jeffries Wyman.*

THE GHILANES, OR MEN WITH TAILS.

Col. Du Couret, the distinguished African traveller, who has recently left Paris to renew his explorations in that country under the auspices of the French government, has addressed to the Academy of Sciences a paper containing an apparent confirmation of the existence of a race in the interior of Africa, the members of which are furnished with tails. The report has been much ridiculed, as an attempt to impose upon the world, but Col. Du Couret would not choose the French Academy as the body to which he would address his memoir, if that were his object.

These people, according to travellers, are originally of the kingdom of Gondar. *They have a tail-like appendage, formed by the elongation of the vertebral column,* and they are the last link in the human race. The slave-merchants cannot dispose of them without great difficulty, so bad is their reputation. The traits which distinguish them are hideous ugliness of face and figure, ungovernable tempers and stolid intellect. Some of this race are to be found also in the Philippine Islands, but they were doubtless carried thither by the slave-merchants. However this may be, when a Levantine is looking out for slaves in the East, he is always warned not to purchase one who has a tail; he is told, "Of all slaves they are the least profitable."

"In 1842, I lived at Mecca," says M. de Couret, "and, being often at the house of an Emir with whom I was intimate, I spoke to him of the Ghilane race, and told him how much the Europeans doubted the existence of men with tails; that is to say, with the vertebral column elongated externally. In order to convince me of the reality of the species, the Emir ordered before me one of his slaves, called *Bellal,* who was about thirty years old, *who had a tail,* and who belonged to this tribe. On surveying this man I was thoroughly convinced. He spoke Arabic well, and appeared rather intelligent. He told me that, in his country, far beyond the Sennaar, which he had crossed, they spoke a different language; this, for want of practice, he had entirely forgotten; that of his countrymen, whom he estimated at thirty or forty thousand, some worshipped the sun, the moon, or stars, others the serpent, and the sources of an immense river, in which they immolated their victims (probably the Nile); that they ate with delight raw flesh, as bloody as possible, and that they loved human flesh above all things; that, after their battles with the neighbouring tribes, they slaughtered and devoured their prisoners without

distinction of age or sex, but that the women and children were preferable, the flesh being more delicate. This Ghilane had become a devout Mussulman, and had lived fifteen years in the Holy City. The fondness, the necessity even, for raw flesh (it really was a want for him) did not fail to return upon him; and his master, therefore, by a precaution, never failed, when this fit was on him, to provide him with an enormous piece of raw mutton, which he consumed ravenously, before every body. This desire for raw flesh showed itself periodically; sometimes twice a week. Being asked why he did not try to correct such a habit, he answered with great frankness, 'I have often tried to overcome this appetite, which I received from my father and mother. In my country, great and small, young and old, live in this manner, besides eating fish, fruits, and vegetables. If any master neglected to supply this requirement of my nature, I am sure I could not resist the desire which possesses me of devouring something, and I should cause great sorrow by falling on some person too weak to contend with me,—an infant, for example.' Having asked him to allow me to see him naked (for I wished to sketch him), he resisted for a long time, but finally yielded, on receiving the promise of an entirely new dress, which I was to send to him; he came privately to my house, where he took off the scanty shirt of coarse blue linen which he wore. I was thus enabled to contemplate him quite at my ease, and to paint his portrait, without exposing him to the punishment which would have been inflicted on him, if he had been detected by his fanatical and superstitious master." The drawing made under these circumstances has been placed under the eyes of the Academy.

Here are some extracts from the description given by M. du Couret of the Ghilanes:—"Ghilanes are a peculiar race of negroes which have a strong resemblance to the monkey; much smaller than the usual race, being rarely more than five feet high. They are commonly ill made; their bodies are lean and seem weak; their arms long and slim; their hands and feet are longer and flatter than those of any other of the human species; their cheeks project, and their forehead is low and receding. Their ears are long and deformed; their eyes are small, black, piercing, and twinkle constantly; their noses are large and flat; their mouths wide, and furnished with teeth very sharp, strong, and of dazzling whiteness. Their lips are full and thick; their hair curled, but not very woolly, not thick, and it remains short. But what particularly distinguishes them is the prolongation of the vertebral column. This gives to each individual, male or female, a tail of two or three inches long."

Finally, here are some other particulars of Bellal, the person the author encountered at Mecca:—"His skin was black-bronzed, shining, soft to the touch, like velvet. His ribs could easily be counted. He had no beard, and his body was not hairy. He was very active and handy. His tail was more than *three inches long*, and almost as flexible as that of a monkey. His disposition, setting aside the oddity of his tastes and habits, was good, and his fidelity was above all praise."

DENTAL PARASITES.

At a meeting of the American Academy, December, 1849, a paper was read by Dr. H. I. Bowditch, on the animal and vegetable parasites infesting the teeth, with the effects of different agents in causing their removal and destruction. Microscopical examinations had been made of the matter deposited on the teeth and gums of more than forty individuals, selected from all classes of society, in every variety of bodily condition, and in nearly every case animal and vegetable parasites in great numbers had been discovered. Of the animal parasites there were three or four species, and of the vegetable one or two. In fact, the only persons whose mouths were found to be completely free from them cleansed their teeth four times daily, using soap once. One or two of these individuals also passed a thread between the teeth to cleanse them more effectually. In all cases the number of parasites was greater in proportion to the neglect of cleanliness.

The effect of the application of various agents was also noticed. Tobacco juice and smoke did not impair the vitality of the parasites in the least. The same was also true of the Chlorine Tooth-wash, of pulverized bark, of soda, ammonia, and various other popular detergents. The application of soap, however, appeared to destroy them instantly. We may hence infer that this is the best and most proper specific for cleansing the teeth. In all cases where it has been tried, it receives unqualified commendation. It may be also proper to add, that none but the purest white soap, free from all discolorations, should be used.

BLOOD-SPOTS ON HUMAN FOOD.

From the siege of Tyre, when Alexander was alarmed by the appearance of bloody spots on the soldiers' bread, to the year 1848, when a similar phenomenon was noticed at Berlin, public attention has been at various times attracted by red discolorations in different sorts of food, and the credulous have ascribed them to a miracle, while others have doubted whether their pretended appearance was not the effect of an excited imagination. But in 1819, M. Sette examined some of these spots, and discovered that they were formed by myriads of small bodies, which appeared to be *microscopic fungi*, and he reported that they were so. In 1848, Ehrenberg's attention was attracted to some of these blood-spots in food, and he commenced studying them, and he now believes them to be, not fungi, but animalcules. These little beings appear as corpuscles, almost round, of $\frac{1}{3000}$ to $\frac{1}{8000}$ of a line in length, transparent when separately examined, but in a mass of the color of blood. M. Ehrenberg calculates that in a space of a cubic inch there are from 46,656,000,000,000 to 884,836,000,000,000 of these monads.—*Medical Times.*

THE UNICORN.

The *London Athenæum* says that M. Antoine d'Abbadie, writing from Cairo, gives the following account of an animal new to Euro-

pean science, which account he received from Baron Von Müller, who had recently returned from Kordofan. "At Melpis, in Kordofan," said the Baron, "where I stopped some time to make my collections, I met a man who was in the habit of selling me specimens of animals, and one day he asked me if I wished for an A'nasa, which he described thus:—'It is of the size of a small donkey, has a thick body and thin bones, coarse hair, and tail like that of a boar. It has a long horn on its forehead, and lets it hang when alone, but erects it immediately on seeing an enemy. It is a formidable weapon, but I do not know its exact length. The A'nasa is found not far from Melpis towards the southwest. I have seen it often in the wild grounds, where the negroes kill it, and make shields of its skin.' This man was well acquainted with the rhinoceros, which he distinguished from the A'nasa under the name of Ferit. This was in April, 1848. In June I was at Kurse, also in Kordofan, where I met a slave-merchant, who was not acquainted with my first informant, and he gave me, of his own accord, the same description of the A'nasa, adding, that he had killed and eaten one not long before, and that its flesh was well flavored." "Herr Rippell and M. Frosnel," adds M. d'Abbadie, "have already mentioned a one-horned African quadruped, and I have with me some notes, which tend to establish the existence of perhaps two different kinds."

ARABIAN CATTLE.

On his return from the Dead Sea Exploring Expedition, Lieut. Lynch brought with him some fine specimens of Arabian cattle, which he presented to the State of Virginia. They are thus described by one who has seen them:—"The khaists are respectively eighteen and sixteen months old, the bull weighing 950 pounds, and the heifer 650. The bull is 4 feet 10 inches high, and 10 feet 4 inches long from the nose to the end of the tail, and the heifer is of proportionate size. Their limbs are as delicate as those of a gazelle, yet as strong and well-set as those of a race-horse. The heads have something of the delicate outline of those of deer, and their nostrils are thin and flexible; their feet are broad and flat, and their tails thick and flat at the roots, but they taper down till very thin, and end in a long tuft of silky hair. The color is a deep shining bay, and the horns, which are but just sprouting, are as black as those of a buffalo. They are said, when full grown, to stand 7 feet high, and the milk of the cows amounts to three half-bushels a day each." They are valued at 10,000 dollars, and have been presented by the State to Col. Castleman, who is to take measures to secure the propagation of the breed.

THE ALPACA.

We find in the *Comptes Rendus* for Jan. 15, a long paper by M. Geoffroy Saint-Hilaire on the alpaca and the alpa-vigogne, or the mongrel of the alpaca and the vigogne, which latter we suppose to be of the goat species. This paper is supplementary to a for-

mer one, but contains many interesting facts. M. St. Hilaire advocates the naturalization of the alpaca in the higher mountains of France, where he thinks they would thrive and be very useful. To show the quantity of the wool consumed, he states that more than 2,800,000 pounds were imported into England as long ago as 1839, and since that time it has much increased, but has not kept pace with the demand, the price having trebled. Several specimens of the wool were produced, and excited much admiration. Among the specimens were two of the wool of the alpa-vigogne. This animal is a mongrel of the alpaca and vigogne, as stated above, and was only produced after long trials. A correspondent from the town of Macucani, in Peru, where the mongrel was first produced, says that he saw twenty-three of them; their size is between that of the alpaca and the vigogne, and their wool is white, from 14 to 15 centimetres long, very fine, and resembling silk. One of the males, however, is coffee-colored. These mongrels are productive, which is the peculiar circumstance about them. The desire of having a wool, which combines the two qualities of great length and fineness, the former of which is found in the alpaca and the latter in the vigogne, suggested the idea of endeavoring to produce the alpa-vigogne, and a Dr. Cabrero, having taken it up, pursued it for several years with great industry. He has finally succeeded in procuring a productive animal, whose wool does unite the two desirable qualities of length and fineness. Another writer describes the mongrel as resembling more the common llama than either of its parents, except that it has straight ears, and the wool, though a very little shorter than that of the alpaca, is infinitely finer.

Some instances having been mentioned where the alpacas decreased in number, when they were found in the same region with sheep, M. St. Hilaire, at the next meeting of the Academy, submitted some facts to show that this was merely the result of peculiar circumstances, and by no means a necessary consequence. It seems that generally the sheep occupy the lower mountains and plains in Peru and Bolivia, while the alpacas occupy the higher mountains, where they are still found in immense numbers; but they also succeed on the lower grounds. In some regions they have disappeared in a measure, but sufficient reasons can be assigned for this, while in other sections they are so abundant, that one writer estimates that he saw over three millions of them in the course of a short journey.

WOOL FROM ABYSSINIA.

M. D'Hericourt placed before the Academy a portion of the fleece of an Ayssinian sheep, the wool of which is in some parts 60 centimetres long. He had endeavored to bring home a male and female of this species, but though the male survived the voyage, the female had died.—*Comptes Rendus, Nov.* 20.

LIBERIAN HIPPOPOTAMUS.

Some additional observations on a living species of hippopotamus of Western Africa, whose existence was first announced by Dr. George Morton, in 1844, have recently been published.

In reference to nomenclature Dr. Morton remarks,—"I first announced this animal by the name of *Hippopotamus minor*, not knowing, at the time, that Cuvier had already given this specific designation to a fossil species. It therefore became necessary to change it, which I do, by placing this species in the zoölogical system by the name of *Hippopotamus (Tetraprotodon) Liberiensis*,—the little or Liberian hippopotamus."

These animals, which are probably the smallest of the hippopotami, vary in weight from four hundred to seven hundred pounds, rarely, however, attaining this maximum. They abound in the River St. Pauls, a stream that rises in the mountains of Guinea, and passing through the Dey country and Liberia, empties into the Atlantic, to the north of Cape Mesurado. They are slow and heavy in their motions, yet will sometimes stray two or three miles from the river, in which situation they are killed by the natives. They are extremely tenacious of life, and almost invulnerable, excepting when shot or otherwise wounded in the heart. When injured they become irritable and dangerous, but are said by the natives never to attack them when in their canoes. The negroes are very fond of their flesh, which seems to be intermediate between beef and veal. The great bulk of the hippopotamus, as well as his amphibious habits, have hitherto prevented his transportation for exhibition; but this smaller species is so moderate in bulk, even in adult age, as to render his capture and transportation of comparatively easy accomplishment, and by a studious adaptation of his food, and attention to his aquatic habits, we can see no great difficulty in introducing the Liberian hippopotamus into the menageries of Europe and America.

MARINE VERMIN.

A skeleton of a marine bird was recently presented to the Boston Natural History Society, which was said to have been prepared in the short space of two hours, by exposure to the attacks of vermin inhabiting the Banks of Newfoundland. These creatures live at or near the bottom, and are said to be very destructive to the cod-fish frequenting the Banks. The bird was lowered to the bottom by means of a loaded line, and drawn up in two hours a perfect, ligamentary skeleton, the flesh having been entirely consumed.

LAZY BEAVERS.

It is a curious fact, that among the beavers there are some that are lazy, and will not work at all, either to assist in building lodges or dams, or to cut down wood for winter stock. The industrious ones beat these idle fellows, and drive them away; sometimes cutting off a

part of their tail, and otherwise injuring them. These *paresseux* are more easily caught in traps than the others, and the trapper rarely misses one of them. They only dig a hole from the water running obliquely towards the surface of the ground twenty-five or thirty feet, from which they emerge, when hungry, to obtain food, returning to the same hole with the wood they procure to eat the bark. They never form dams, and are sometimes to the number of five or seven together; all are males. It is not at all improbable, that these unfortunate fellows have, as is the case with the males of many species of animals, been engaged in fighting with others of their sex, and, after having been conquered and driven away from the lodge, have become idlers from a kind of necessity. The working beavers, on the contrary, associate, males, females, and young, together.—*Audubon and Bachman's Quadrupeds of North America.*

THE AMERICAN BISON IN FRANCE.

M. Lamare Piquot, who has travelled extensively in our Western country, has addressed a memoir to the Paris Academy of Sciences on the naturalization and domestication, in France, of the American *bison.* He urges that the animal is remarkably strong and swift; that it would be fit for draught in the operations of husbandry and domestic business; and that it would contribute a new meat of agreeable flavor. He considers the animal as the finest and the most useful of the native productions of the Great West. He relates, that he saw it hunted on the banks of the Mississippi and the Missouri, and that, from the facility of destroying it, he fears the species will soon disappear. The French laborers, in town and country, have scarcely any other food than bread and vegetables, on account of the high price of meat; therefore it is highly important to multiply the meats. The bison, he adds, has been domesticated on the Red River, and the flesh found excellent after it has been five years in that state. In proof of their powers of endurance, he cites an instance, in which an animal at four years of age performed a journey of seventy-five miles in a day; and on the morrow, dragged back, by eleven at night, a load of eight hundred pounds.

SEXES IN THE OYSTER.

M. Quatrefages, in a communication to the French Academy, states, that long investigation has induced him to believe that the common opinion that the sexes are united in the oyster is erroneous. These observations have been confirmed by those of M. Blanchard. Both of these gentlemen advocate the artificial propagation of the oyster.

ON THE ZOÖLOGICAL CHARACTER OF YOUNG MAMMALIA.

At the meeting of the American Association, Prof. Agassiz remarked, that zoölogists have, in their investigations, constantly neg-

lected one side of their subject, which, when properly considered, will throw a great amount of new light on their investigations. Studying animals, in general, it has been the habit to investigate them in their full-grown condition, and scarcely ever to look back for their characters in earlier periods of life. We scarcely ever find, in a book on natural history, a hint as to the difference which exists in the young and old. Perhaps in birds the color of the young may be noticed; and it is generally known that the young resemble the female more than the male; but as to precise investigation of the subject, we are deficient. But if the early stages of life have been neglected, there is one period in the history of animals which has been thoroughly investigated, for the last twenty-five years,—embryology. The changes which take place within the egg itself, and which give rise to the new individual, have been thoroughly examined; but, after the formation of the new being, the changes in its form which it passes through, up to its full-grown condition, have been neglected. It had been his object to investigate this subject, because he had been struck with the deficiency there is on this point in our works; and, in making this investigation, he had found that the young animals, in almost all classes, differ widely from what they are in their full-grown condition. For instance, a young bat, a young bird, or a young snake, at a certain period of their growth within the egg, resemble each other so much that he would defy the most able zoölogist of our day to distinguish between a robin and a bat, or between a robin and a snake. There is something of high significance in this fact. There is something common to all these. There is a thought behind these material phenomena, which shows that they are all combined under one rule, and that they only come, under different laws of development, to assume, finally, different shapes, according to the object for which they were introduced.

There is a period of life, in which, whatever may be the final form of their organs of locomotion, whatever may be the final difference between the anterior and posterior extremities, vertebrated animals have uniform legs in the shape of little paddles or fins. This is the case with lizards as well as birds. A robin's wing and a robin's leg, which are so different from a bat's wing and a bat's leg, do not essentially differ when young from the leg and arm of a bat. Wherever we observe combined fingers preserving this condition, we have a decided indication that such animals rank lower in the group to which they belong. This is all-important, as we are enabled at once to group animals, which are otherwise allied, in a natural series, as soon as we know whether they have combined or divided fingers. And the degree of division to which the legs rise in their development is a safe guide in our classification. Look, for instance, at the legs of dogs and cats, in which the fingers are completely separated, and so elongated that the animals walk naturally upon tiptoe, and compare them with others, bears, for instance, which walk upon the whole sole of the foot, and again with those of seals or bats, which remain united, and constitute either fins or a wing.

There are other reasons sufficient to convince us that the order of

arrangement which he had assigned them, according to the development of the fingers, is justified by the state of development of the other organs of the Mammalia, and especially of their higher organs and intellectual faculties and instincts. And I will also add, says Prof. Agassiz, that mankind are not excluded from this connection, but, in common with other Vertebrata, we are all at one stage of existence provided with paddles or fins, which are afterward developed into legs and arms.

ON THE CANCELLATED STRUCTURE OF SOME OF THE BONES OF THE HUMAN BODY.

The following results respecting the arrangement of cancelli,* have been deduced by Dr. Jeffries Wyman from the structures of various bones of the human body, especially those which assist in maintaining the body in its erect position:—1. The cancelli of such bones as assist in supporting the weight of the body are arranged, either in the direction of that weight, or in such a manner as to support and brace those cancelli which are in that direction. In a mechanical point of view, they may be regarded in nearly all these bones as a series of "studs" and "braces." 2. The direction of these fibres in some of the bones of the human skeleton is characteristic, and, it is believed, has a definite relation to the erect position which is naturally assumed by man alone.

The cancelli of some bones have been described or referred to by various authors, but the description of the neck of the thigh-bone, as given by Dr. Wyman, is different from that of any other preceding writer.

The whole weight of the head, trunk, arms, and pelvis rests on the heads of the two thigh-bones, or more or less on one of them, according to the attitude of the body when in a state of rest. When the body is in motion, they will sustain, in addition to this, the momentum of the trunk as it descends upon them in walking, running, jumping, &c. The heads of the bones are themselves immediately supported by the neck, the axis of which forms an angle of about 120° with that of the shaft of the bone, if the lower angle be measured, or of 60° if the upper. The weight of the body will, therefore, have an angular bearing upon the axis of the neck, and its tendency will be to bend or break the neck in a downward direction. The means which nature has adopted to counteract this tendency consist,—1. In making the vertical diameter of the neck the largest, a section at right angles to its axis being oval, and the long diameter perpendicular. 2. In increasing the thickness of the wall of bone on the under side of the neck and adjoining portion of the shaft, on to which a large portion of the weight of the body is directly transmitted. 3. In having the cancelli of each femur so arranged as to

* *Cancelli*, the Latin term for lattices, or windows made with cross-bars of wood, iron, &c.; hence it is applied to the spongy structure of bones, and the term *cancellated*, to anything which is cross-barred or marked by lines crossing one another.

form a segment of a framed arch or truss, which coöperates with the external shell in sustaining the weight of the body; the necks of the two femora forming together opposite segments of an arch. The first and second of these conditions have been frequently adverted to by anatomical writers, but the third has almost invariably escaped observation.

As regards the structure of other bones, Dr. Wyman also shows in what direction force or weight is applied to them, and in what direction the cancelli are arranged within them. On the lumbar vertebræ there is vertical pressure; within, the principal fibres are also vertical. On the neck of the thigh-bone the weight of the body is applied obliquely to the end of an arm; within it, there is a combination of fibres, giving strength with lightness, which forms a frame mechanically adapted for resisting the weight which rests upon it. On the astragalus the pressure again is vertical, but this bone rests on two others, one below it, the os calcis, and the other in front, the scaphoides; within there exist two series of cancelli, directing the pressure on the surfaces of support, and very nearly the same description applies to the os calcis. A certain direction of fibres in all these instances coexists with a certain direction, or certain directions, of the transmission of pressure. From this constant association of structure and function, the inference seems unavoidable, that they are means and ends.—*Proc. Bost. Soc. Nat. Hist.*

METAMORPHOSES OF THE LEPIDOPTERA.

PROF. AGASSIZ said that he had during the past season been studying the metamorphoses of the Lepidoptera, and, to his great surprise, he had found that one stage in the transformation of these insects has been overlooked by naturalists. We knew the Lepidoptera in three conditions,—that of the worm, furnished with jaws and jointed, the chrysalis, and the perfect insect, with four wings. The change not before described, which he had noticed, is somewhat concealed under the skin of the caterpillar. The animal at a certain period swells at the thoracic region, and becomes extremely sensitive to the touch in this part, the skin being, in fact, in a state of inflammation. On cutting open the skin at this place, Prof. Agassiz found beneath it a four-winged insect, before it had passed into the chrysalis state. The wings were long enough to extend half the length of the perfect insect. The posterior pair he found to be membranous bags, somewhat flattened, like the respiratory vesicles of marine worms, with distinct ribs, which are blood-vessels. The anterior pair are also bags, with their upper half stiff and inflexible, like the elytra of Coleoptera. The legs are tubular, but not joined, as in the perfect insect. The jaws are changed into two long tubes, which are bent backwards, as are also the antennæ. In the chrysalis the wings are flattened and soldered together, as are the legs and sucking-tubes, which are bent backwards. The order of development of the different parts, and the coleopterous condition at an incomplete stage, show that naturalists have been in error in placing chewing in-

sects, as the coleoptera, above the sucking insects. The order should be reversed. Prof. A. said that he had confirmed his observations in many specimens by examining them just at the moment when the skin begins to split on the back.—*Proc. Bost. Nat. Hist. Soc.*

ON THE CIRCULATION AND DIGESTION OF THE LOWER ANIMALS.

PROF. AGASSIZ states that the circulation of the Invertebrata cannot be compared to that of the Vertebrata. Instead of the three conditions of chyme, chyle, and blood, which the circulating fluid of the Vertebrata undergoes, the blood of that class of the Invertebrata which he had particularly studied, the Annelida, or worms, is simple colored chyle. The receptacles of chyle in different parts of the body are true lymphatic hearts, like those found in the Vertebrata; this kind of circulation is found in the Articulata, and mollusks, with few exceptions, and in some of the Echinoderms. In the Medusæ and Polyps, instead of chyle, chyme mixed with water is circulated; this circulation is found in some mollusks and intestinal worms. Prof. Agassiz thinks that the embryological development of the higher animals shows a similar succession in the circulating function. As regards the connection between respiration and circulation in Vertebrata, the gills are found between branches of the blood system; in Invertebrata, the chyliferous system is acted on by the respiration. The gills of fishes, therefore, cannot be compared to the gills of Crustacea, Articulata, and mollusks. In fact, no gills are connected with the chymiferous circulation. Animals having this circulation have no true respiration. They have only tubes to distribute freshly aerated water to different parts of the body.—*Proc. Bost. Nat. Hist. Soc.*

THE DODO.

THE dodo is, or rather was, a curious bird which existed in the Mauritius some two hundred years ago, but which is now extinct, and is known only by a part of a skull, a head, and two feet, preserved in different European museums, and by some half-dozen rude figures of it. There are, however, some vague hints of the bird in the records of some Dutch travellers, beginning at the end of the sixteenth century, and extending for fifty years. A question of much interest has arisen amongst zoölogists, as to what section of birds the dodo belonged, and probably no question, not even excepting the existence of the sea-serpent, has given rise to more discussion. Mr. Vigors considered it to be a gallinaceous bird, allied to the ostriches. M. de Blainville and Mr. Gould referred it to the order comprising the vultures and eagles. Prof. Owen, after a lengthened examination, adjudged it to be a vulture or raptorial bird. Prof. Reinhardt first suggested that it might be a large form of the Columbidæ or pigeon tribe, and a pigeon it appears to be.

Thus much we find in the *London Athenæum*, which, in an article reviewing a new book on the dodo, comes to the above conclusion; but now up starts another learned gentleman with, as he claims, pos-

itive proof that the dodo should be placed elsewhere in the classification. The JAMESON'S JOURNAL FOR JULY states that Mr. Brandt has received some interesting details regarding the dodo from the Directors of the Museum of Natural History of Copenhagen, where the portion of the skull spoken of above is preserved. Mr. Brandt has made a careful examination, and comes to the conclusion, that the dodo must be placed among the Grallæ, and, in confirmation of his view, he announces that he has discovered certain osselets which are peculiar to the cranium of the Grallæ.

NERVOUS SYSTEM OF FROGS.

AT a meeting of the Boston Natural History Society, in July, 1848, Dr. Wyman communicated some results obtained by dissections of the nervous system of Frogs. He had found attached to the trunk of each of the spinal nerves, just before their division into motor and sensitive roots, a vesicle containing a white, chalky substance, which, under the microscope, was shown to be composed of vast numbers of minute crystals [probably carbonate of lime], each having an hexagonal form, and terminated at either extremity by a six-sided pyramid. The sac containing them was well defined, about half a line in diameter, and subdivided internally by numerous septa into small cavities, in which the crystals were lodged. Nervous filaments were traced into the interior of the sac. A deposit of similar crystals was also noticed around the veins in the spinal canal, and on the base of the cranium.

The chalky matter found in the vestibule of the ear he proved by the microscope to be composed of crystals similar in size and appearance to those found attached to the spinal nerves. He had sought for them in great numbers of frogs, of different species, and in no instance had he failed to detect them. He had not found them in the Menobranchus or in tortoises, except in the vestibules of the latter. From their constant presence in frogs, he was disposed to regard them as essential parts of their nervous system.

In connection with this subject we may mention that Blasius quotes Swammerdam, as having noticed a substance like lime, which effervesced with acid, as being situated on each side of the spinal column. See Blasius, *Anatomia Animalium*, p. 291.—*Proc. Bost. Nat. Hist. Soc.*

DISEASES OF SILK-WORMS.

IN the *Comptes Rendus*, for Nov. 5th, we find a paper by M. Guérin-Meneville, on the "Diseases of Silk-Worms," in which he says:—"This year my examination of silk-worms, both healthy and diseased, has led me to observe some very curious facts. I think that I have aided in the transformation of living animal matter into a plant, for I have seen certain corpuscules, forming the living and interior of the globules of the blood of silk-worms, become the rudiments of the *Botrytis bassiana*, the plant which causes the disease known under the name of *muscardine*." After mentioning several similar phe
already known, to show that his discovery is not entirely un

ed, M. Meneville continues,—"Examined by means of the microscope, immediately after its issue from the body, the blood of healthy silk-worms is seen to consist of an albuminous transparent liquid, without color in those worms which produce the white silk, and of a golden yellow in those which produce the yellow silk. In this liquid there is an innumerable quantity of almost spherical globules, whose size is very small, the diameter of the largest not exceeding the hundredth of a millimetre. These globules, which appear to possess life, are developed and reproduced continually during the life of the animal, and at different periods they exhibit the following modifications:—1. Those which appear newly formed are smaller, and their centre exhibits only a single point which is somewhat less transparent than the rest. 2. A little later, the globule has increased, and a nucleus is seen at the centre, consisting of several perfectly equal granules, which seem to give to this nucleus an expanding and contracting motion. 3. At another period in the life of the globules, these granules separate, and join the circumference. 4. Finally, these same granules have a tendency to come out from the globule by breaking its envelop, and this they soon do, forming, as soon as they come forth, other globules, similar to the parent ones, and becoming covered with a transparent membrane, whose formation is probably aided by the contact with the albuminous liquid which is their nourishment.

"The above appearances are invariably presented by healthy animals, but in diseased ones the case is very different. If blood is taken from silk-worms weakened by any of the diseases except the *muscardine*, it is found that the globules in the blood decrease in number as the animal is more or less diseased. Then the albumen is filled with little animated corpuscles, which are more numerous in proportion as the healthy globules are less so. These animated corpuscles are all of exactly the same size, one four-hundredth of a millimetre, oval and kidney-shaped, and they have no appearance of possessing vibrating cilia or other external locomotive organs. They move, however, very rapidly, and are evidently the same as those seen in the healthy globules, for they have often been detected coming forth from them. It seems to me to be also evident that these granules are the rudiments of new globules of blood, when they are produced in the blood of a healthy silk-worm, but that they want some essential qualities, when they are formed in a diseased animal, so that their development is arrested.

"I propose to call these granules *hæmatozoides*. In silk-worms which are dying of *muscardine*, whether they have received the seeds of the disease naturally or have been artificially infected, the phenomena occur very differently. A long time before the death of the worm, and even before its disease is shown by any external signs, there is found in their blood some *hæmatozoides*, which increase in number from hour to hour, and with which are mingled some little navicular bodies, at first very short, and which are soon seen to become the rudiments of the *Botrytis muscardinique*. At this period of the disease I have been able to establish the moment in which many of the animated corpus- ...re transformed into plants.

"Thus, if this fact is confirmed, we must admit that these animated corpuscles are elementary globules possessing life, which leave the globules of blood to reproduce them. In a diseased state of the worm they either die and become decomposed, constituting the diseases which produce the liquefaction of the worms, or else they are changed into the rudiments of plants, whose development causes filaments to penetrate into all the organs, and thus to produce the hardening, the absorption of the fluids, and all the phenomena of *muscardine.* If a drop of the blood infected with *muscardine* is left before the microscope, and exposed to moisture, these rudiments are seen to grow and to ramify, so as finally to produce the *Botrytis muscardinique*, as mentioned above.

"From these facts it results that we can, by examining the blood of silk-worms, know at once whether they are in a healthy state or not, and this, too, long before it could be known by any external signs."

THE EFFECT OF CHLOROFORM WHEN INJECTED INTO THE ARTERIES.

M. Coze, in a memoir read to the French Academy, on April 23d, says:—"Chloroform, when injected into the arteries, produces in the muscles to which these vessels are distributed a great increase of contractibility. Thus, when chloroform is injected into the artery in the leg of a rabbit, there is at once a muscular contraction so powerful, that the flesh seems to have acquired the hardness of wood. The chloroform does not seem to act in a direct manner upon the blood, by decomposing or coagulating it, nor does it seem any more to act directly upon the nerves, but the contraction is an entirely local phenomenon, which takes place only where the chloroform comes in actual contact." However it may act, it is certain that the hardening of the muscles caused by it even lasts a long time after death, and in one case the body of an animal thus injected was kept for a week without exhibiting the least signs of putrefaction.

CAUTERIZATION IN THE CASE OF POISONOUS BITES.

In the *Comptes Rendus* for Jan. 8th, we find an article by M. Parchappe, containing the result of his observations on the question, whether the spread of poison produced by a bite can be prevented by cauterizing. He was induced to examine into this subject, because M. Renard had stated that cauterization was found to have no effect when applied even within five minutes after the bite in the case of one sort of virus, and within one hour in that of another. These results, he was aware, though derived from experiments upon animals, would weaken the confidence of physicians and patients in the only mode that medicine possesses of preventing the bad effect of a bite from any poisonous animal, where, as is generally the case, some considerable time must elapse before the remedy can be applied. M. Parchappe accordingly made several experiments upon dogs with an extract of

nux vomica, all of which go to confirm him in ascribing to cauterization a power even greater than that commonly allowed it. "From these experiments it results that the immediate amputation or destruction of the living portion with which the extract of nux vomica has come in contact, has the power of preventing the bad effects of the poison, even when it has been in contact for some time." The author is aware that there is considerable difference between the virus of animals and the substance used by him, with reference to their direct and remote effects, but thinks that every one must admit that here is a great *analogy* between them. He is of the opinion, that in both cases the poison remains in the bitten part for a considerable time before it is transmitted to the rest of the body, and that cauterizing should be adopted in all cases where a poisonous bite is even suspected.

INVESTIGATION RESPECTING THE CAUSES WHICH PRODUCE A BLISTER.

By a series of experiments made at the Lawrence Scientific School, Dr. Breed has shown that a certain degree of pressure may entirely counteract the blistering effect of cantharides, and also that produced by steam of 212°, or boiling water. It has likewise been demonstrated, that cutaneous evaporation is not essential to the formation of a blister.—*Editors.*

THE POISON OF SPIDERS.

At a recent meeting of the Linnæan Society, Mr. Blackwall communicated a paper on the alleged power possessed by spiders of poisoning whatever they bite. He states, that in the summer of 1846 he commenced an experimental investigation of the subject, the particulars of which he communicates, arranging his experiments under four distinct heads, corresponding to the objects upon which they were made, namely, the human species, spiders, insects, and inanimate substances. We can only give his results, which are as follows. First, as regards the effect of the bite of spiders upon the human species. Mr. Blackwall states, that the conclusion properly deduced from his various experiments is, that there is nothing to apprehend from the bite of the most powerful British spiders, even when inflicted at a moment of extreme irritation, and in hot, sultry weather, the pain occasioned by it being little, if any, more than is due to the laceration and compression which the injured part has sustained. Under the second head, the observations were made on both the male and female of various spiders, and the result is, that extensive mechanical injuries commonly prove fatal to spiders, whether received in conflicts or otherwise; but the experiments supply no evidence indicating that the fluid emitted from the fangs of the spider possesses a property destructive to the existence of animals of that order, when transmitted into a recent wound.

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Thirdly. The author concludes that his experiments do not present any facts which appear to sanction the opinion, that insects are deprived of life with much greater celerity when pierced by the fangs of spiders than when mechanically lacerated to the same extent in other ways. It is true, however, that the catastrophe is greatly accelerated, if the spiders maintain their hold for some time, but this is to be attributed to the extraction of their fluids by deglutition into the stomachs of their adversaries.

Fourthly. In his experiments on inanimate substances, Mr. Blackwall found that litmus paper presented to spiders belonging to several genera, when they were in a state of extreme irritation, and moistened by the transparent fluid which issues under such circumstances from the fissure near the extremity of the fangs, invariably became red as far as the fluid spread, clearly proving that this secretion, although tasteless, is an acid. On the other hand, the fluid that flows from the mouth, as also that contained in the stomach, and that which is discharged from wounds inflicted on the body or limbs, were found by the same chemical test to be alkaline. Turmeric paper was rendered brown by the application of the fluids from the mouth and stomach, and restored to its original color by the agency of the fluid secreted in the so-called poison gland, thus affording complete proof of the respectively alkaline and acid natures of these several secretions.—*Mag. of Nat. History.*

CONSUMPTION.

AT the last regular meeting of the National Institute, Dr. Riofrey, of Paris, made some very interesting and scientific observations on the subject of consumption. *Post mortem* examinations had shown that nature, under certain circumstances, cures the disease. It was important to inquire what these circumstances were. From the extensive field of the author's remarks on France, Holland, and Great Britain, it appeared that a cure was effected whenever thin and attenuated men changed their climate and habits, one or both, and in consequence developed a tendency to become fleshy; he considered a high *northern* and *southern* latitude alike favorable. He named the American coasts from latitude 55 degrees north to 17 degrees south as consumptive latitudes. He deemed all the temperate latitudes unfavorable.

Prof. Maury said that latitude 17 degrees south was precisely the point where the trade-winds, relieved from their moisture by the Andes, produced a dry air. Dr. Gale said that Natchez was a favorable point, in the Mississippi valley, for consumptives; yet Natchez had a very humid climate. Dr. Borland (U. S. Senate) confirmed these views. The nights were exceedingly damp. The wind blew up the river, bringing the dampness from the Gulf. Prof. Henry attributed the deleterious effects in consumption rather to the amount of *change* in the thermometer at given points than to the actual state of temperature. Prof. Maury represented the coasts of Patagonia as literally submerged with rain; twenty-one feet of rain had actually fallen in 31

days; and he represented the natives as physically a most miserable race. Mr. Schoolcraft said, that it was then a popular error that they were of taller stature than other Indians.—*National Intelligencer.*

DISTRIBUTION OF THE TESTACEOUS MOLLUSCA OF JAMAICA.

THE great number of species is remarkable. A few miles of coast, without the aid of storms, and without dredging, yielded 420 species. In the small bay of Port Royal, 350 marine species were found. A pint of sand, taken from a surface 3 yards long, contained 110 species. Probably there are 350 or 400 specimens of land shells, and two or three times as many of marine species. Extensive districts occur, however, which are nearly destitute of land or marine shells. They are accumulated in favorable stations.

The difference in the extent of the distribution of the marine and of the terrestrial species is remarkable. A majority of the marine species are known to occur in the other islands; probably not more than 10 or 15 per cent. of them will be found to be peculiar to Jamaica. But of the land shells, 95 per cent. are peculiar to the island. The limited distribution of the terrestrial species is remarkable. A few are generally distributed, but a large number are limited to districts of a few miles in diameter, and several, although occurring abundantly, could be found only within the space of a few rods. Only 17 fresh-water species were found. Favorable stations for fresh-water species are rare.

In respect of the number of individuals of Mollusca in Jamaica, as compared with more northern latitudes, the rule so obvious in the class of fishes is not applicable to the same extent. Of fishes, the species are much more numerous, but the individuals much less so. Of the Mollusca, the total number of individuals is about the same as in this latitude, and the number of species represented by a profusion of individuals is about the same. But the number of species not occurring abundantly is much greater, so that the average of individuals to all the species is less than in this latitude. From a comparison of the laws of distribution of the marine and terrestrial species in the Antilles, it follows that the number of the latter must exceed that of the former. With the insular distribution of the terrestrial species may be associated the fact, that the coral reefs are all fringing, for both facts are connected with the geological fact, that these islands are in a process of elevation.—*Prof. Adams before the American Association.*

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ASTRONOMY AND METEOROLOGY.

KIRKWOOD'S ANALOGY.

At the recent meeting of the American Association, an announcement was made, which, if it is found to be correct, will be regarded as relating to one of the most important discoveries which have been made in astronomy for years. It is no less than a new law of the solar system, closely resembling those of Kepler, which form the groundwork of many of the problems of Astronomy. Mr. S. C. Walker read to the Association a letter from Mr. Daniel Kirkwood, of Pottsville, Pa., the discoverer of this new law, from which we make some extracts, omitting all that refers to the higher branches of mathematics.

"While we have in the law of Kepler a bond of mutual relationship between the planets, as regards their revolutions around the sun, it is remarkable that no law regulating their rotations on their axes has ever been discovered. For several years I have had little doubt of the existence of such a law in nature, and have been engaged, as circumstances would permit, in attempting its development. I have at length arrived at results, which, if they do not justify me in announcing the solution of this important and interesting problem, must at least be regarded as astonishing coincidences."

After stating some equations, he gives the following tables as the data on which he has proceeded.

Planet's name.	Mean dist. from the Sun in miles.	Mass.	Square root of mass.	No. of rotations in one sid. period.
Mercury,	36,814,000	277,000	526.3	87.63
Venus,	68,787,000	2,463,836	1569.6	230.90
Earth,	95,103,000	2,817,409	1678.5	366.25
Mars,	144,908,000	392,735	626.7	669.60
Jupiter,	491,797,000	953,570,222	30879.8	10,471.00
Saturn,	907,162,000	284,738,000	16874.1	24,620.00
Uranus,	1,824,290,000	35,186,000	5931.5	

From these data he deduces the following law:—"*The square of the number of a primary planet's days in its year, is as the cube of the diameter of its sphere of attraction in the nebular hypothesis.*"

"The points of equal attraction between the planets severally (when in conjunction) are situated as follows:—

		Miles from the former.	Miles from the latter.
Between	Mercury and Venus,	8,029,600	23,943,400
"	Venus and Earth,	12,716,600	13,599,400
"	Earth and Mars,	36,264,600	13,540,400
"	Jupiter and Saturn,	266,655,000	145,710,000
"	Saturn and Uranus,	678,590,000	238,538,000

"It will be seen from the above, that the diameter of the earth's sphere of attraction is 49,864,000 miles. Hence the diameters of the respective spheres of attraction of the other planets, according to my empirical law, will be found to be as follows:—

	Diam. of Sph. of Attr.
Mercury	19,238,000
Venus	36,660,000
Mars	74,560,000
Jupiter	466,200,000
Saturn	824,300,000

"The volumes of the sphere of attraction of Venus, Mars, and Saturn, in this table, correspond with those obtained from the preceding one; that of Mars extending sixty-one million miles beyond his orbit, or to the distance of two hundred and six million miles from the sun. This is about two or three million miles less than the mean distance of Flora, the nearest discovered asteroid. That of Mercury extends about eleven million miles within the orbit; consequently, if there be an undiscovered planet interior to Mercury, its distance from the sun, according to my hypothesis, must be less than *twenty-six* million miles. Jupiter's sphere of attraction extends only about *two hundred* million miles within his orbit, leaving eighty-nine million miles for the asteroids. It is only in the most distant portion of this space, where small bodies would be less likely to be detected, that none have yet been discovered."

Mr. Kirkwood then modestly concludes:—"The foregoing is submitted to your inspection with much diffidence. An author, you know, can hardly be expected to form a proper estimate of his own performance. When it is considered, however, that amy formula involves the distances, masses, annual revolutions, and axial rotations, of all the primary planets in the system, I must confess I find it difficult to resist the conclusion, that the law is founded in nature."

After this letter had been read, Mr. Walker said, that, induced by the importance of the subject, he had at once proceeded to verify the data and conclusions of Mr. Kirkwood, and had found that there was nothing in them requiring modification, except, perhaps, the substitution of some more recent values for the masses of Mercury and Uranus. This theory, and that of Laplace with reference to nebulæ, mutually strengthen each other, although the latter has been a mere supposition, while the former rests upon a mathematical basis. In a later letter, which was also read, Mr. Kirkwood says that he has pur-

sued this subject for the last ten years, it having been first suggested to him by the nebular hypothesis, which he thought could be established by some law of rotation.

Mr. Walker then entered into a lengthened examination of the data on which the law rests, and seemed to come to the conclusion, that, as far as we know at present, everything is in favor of the truth of the law, except that it requires the assumption of another planet between Jupiter and Mars.

Mr. Walker closed his examination by saying,—"We may therefore conclude, that, *whether Kirkwood's analogy is or is not the expression of a physical law, it is at least that of a physical fact in the mechanism of the universe.* The quantity on which the analogy is based has such immediate dependence upon the nebular hypothesis, that it lends strength to the latter, and gives new plausibility to the presumption that this, also, is a fact in the past history of the solar system.

"Such, then, is the present state of the question. Thirty-six elements of nine planets (four being hypothetical) appear to harmonize with Kirkwood's analogy in all the four fundamental equations of condition for each planet. To suppose that so many independent variable quantities should harmonize together by accident, is a more strained construction of the premises than the frank admission that they follow a law of nature.

"If, in the course of time, the hypotheses of Laplace and Kirkwood shall be found to be laws of nature, they will throw new light on the internal organization of the planets, in their present and in any more primitive state through which they may have passed. For instance, we may compute the distance from the centre at which any planet must have received its projectile force in order to produce at the same time its double movement of translation and rotation.

"If the planet in a more primitive state existed in the form of a ring revolving round the sun, having its present orbit for that of the centre of gravity of the ring, the momentum of rotation must, by virtue of the principle of conservation of movement, have existed in some form in the ring. It is easy to perceive that this momentum is precisely the amount which must be distributed among the particles of the ring, in order to preserve to all the condition of dynamical equilibrium, while those of each generating surface of the ring were wheeling round with the same angular velocity.

"If the planets have really passed from the shape of a revolving ring to their present state, the prevalence of Kirkwood's analogy shows a nice adaptation of parts in every stage of the transition.

"If the primitive quantity of caloric (free and latent) had undergone a very great change beyond that now indicated in the cooling of their crusts; if the primitive quantity of movement of rotation had been different from its actual value for any planet; if the law of elasticity of particles for a given temperature and distance from each other varied from one planet to another in the primitive or present states; in either of these cases, the analogy of Kirkwood might have failed. As it is, no such failure is noticed; we are authorized, therefore, to conclude, that the primitive quantity of caloric, the law of elasticity, the

quantity of movement of rotation, the past and present radii of percussion, the primitive diameter of the generating surface of the rings, and the present dimensions and density of the planets, have been regulated by a general law, which has fulfilled for all of them the four fundamental conditions of Kirkwood's hypothesis.

"We may extend the nebular hypothesis and Kirkwood's analogy to the secondary systems. If they are laws of nature, they must apply to both. In the secondary systems, the day and month are the same. This fact has remained hitherto unexplained. Lagrange showed that if these values were once nearly equal, a libration sets in round a state of perfect equality; but he offered no conjecture as to the cause of the primitive equality. On the nebular and Kirkwood's hypothesis, it would only be necessary that, upon the breaking up of the ring, the primitive diameter of the generating figure and law of relative density of layers should be preserved."

Prof. Peirce, whose opinion will probably be regarded as of more value on such a subject than that of any other man in this country, especially since his successful discussion with Leverrier, remarked, that Kirkwood's analogy was the only discovery of the kind since Kepler's time, that approached near to the character of his three physical laws. Bode's law, so called, was at best only an imperfect analogy. Kirkwood's analogy was more comprehensive and more in harmony with the known elements of the system. The diameter of the sphere of attraction, a fundamental element in this analogy, now for the first time gave an appearance of reality to Laplace's nebular hypothesis, which it never had before. The positive testimony in its favor would now outweigh the former negative evidence in the case, however strong it may have been. It follows at least from Kirkwood's analogy, that the planets were dependent upon each other, and therefore connected in their origin, whatever may have been the form of the connection, whether that of the nebular hypothesis, or some other not yet imagined.

At a later period of the meeting, Mr. B. A. Gould, Jr., stated that he had gone through the necessary calculations, using different quantities, and had come to the same conclusions as Mr. Walker. He expressed his opinion, that at some future day the world will "speak of Kepler and Kirkwood as the discoverers of great planetary laws."

The members generally expressed the opinion, that Laplace's nebular hypothesis, from its furnishing one of the elements of Kirkwood's law, may now be regarded as an established fact in the past history of the solar system.

SHOOTING STARS OBSERVED IN 1849.

THE following observations on the periodical occurrence of shooting stars have been made in various parts of the country during the year 1849. On the night of the 20th of April, 54 different meteors were observed in New Haven, as follows:—in the northwest, 23; in the south, 21; in the northeast, 10. There was nothing remarkable in these as to brilliancy, nor was there any decided point of radiation.

As usual, there was a general motion towards the west. The conclusion arrived at by the observers was, that the number of meteors was not greatly beyond the average.

The meteors, however, of the 10th of August, seem to have appeared in their usual numbers. At Canonsburg, Penn., between the hours of 10 P. M. and 12½ A. M., 260 meteors were observed in all. They appeared with great regularity, about an equal number in each quarter of the heavens, and each successive half-hour. About nine tenths of all observed moved towards the southwest, the remaining tenth traversing the heavens in all directions. There was no central point of emanation, though a majority, perhaps, of the whole, appeared to originate in the directions of Cassiopeia and Ursa Major. On the night of the 11th of August, also, meteors were more than usually abundant, but by no means so numerous as on the evening of the 10th. At Mineral Point, Wisconsin, numerous shooting stars were observed on the night of the 9th of August.

At the Cambridge (Mass.) Observatory, although the sky was clear, very few meteors were observed on the 12th and 13th of November.

In France, M. Coulvier-Gravier's observations for the August period of shooting stars again this year confirm his views, that the phenomenon is progressive, and not a sudden appearance in great numbers about the 10th of the month. It will be seen, by the subjoined table of his observations, that the increase continued from the 10th of July to the 10th of August, diminishing on the night of the 11th.

July	10,	6	shooting stars.	July	26,	26	shooting stars.
"	11,	8	"	"	27,	28	"
"	13,	10	"	"	28,	33	"
"	14,	7	"	Aug.	6,	50	"
"	15,	10	"	"	8,	60	"
"	20,	13	"	"	9,	107	"
"	21,	13	"	"	10,	120	"
"	22,	12	"	"	11,	70	"

In November, the maximum number noticed by M. Gravier amounted to only 40, but they lasted for several days.

The series of observations made by M. Coulvier-Gravier from July, 1841, leads to the general result, that, from December 21st to June 21st, the number of meteors is much smaller than in the second half of the year.

AN AMERICAN PRIME MERIDIAN.

At the meeting of the American Association, in August, a paper on the subject of an American Prime Meridian was presented by Lieut. Davis, U. S. N., from which the following extracts are taken.

"It is a question whether, having a National Observatory, and being about to publish an American Nautical Almanac, we shall still continue to count our longitude from the meridian of Greenwich, or whether it is preferable for convenience, for accuracy, or for other reasons, to establish a new prime meridian on this continent. It would

undoubtedly be for the advantage and convenience of all civilized nations if a general meridian were adopted by common consent; if all longitudes were counted in the same manner, and from a single origin. Hitherto we have used the English meridian of Greenwich; all our geographical positions and territorial limits are fixed according to that, our astronomical calculations are based upon it, our nautical charts and books of navigation are adapted to it, and our chronometers are set to its time. It has been so much our general practice to count from this meridian, that it constitutes a part of our familiar thought and knowledge. On this account, and especially with reference to the convenience of our wide-spread and growing commerce, a change of the old meridian, if necessary, should be reconciled, as far as practicable, to the wants and habits of the country.

"The scientific importance of assuming, at present, an American meridian is undoubted. So long as we depend upon that from which we are separated by an ocean, our absolute longitudes remain indeterminate. Such are the difficulties attending the astronomical determination of this element, that the greatest accuracy attained is only an approximation to the truth; varying, as observations or computations are multiplied, or as new and better methods and values are introduced. There is no place on our coast, the longitude of which from Greenwich is so well ascertained as Boston. The observations and computations made for this purpose by the late Dr. Bowditch, and communicated to the American Academy, bear the marks of his genius and labor. Mr. Bond, the director of the observatory at Cambridge, has been for several years employed in the service of the government, in accumulating all the means of perfecting the longitude of Boston. Yet there still exists an uncertainty in this longitude, notwithstanding all the labor and care bestowed upon it, to the amount of, perhaps, two seconds of time. It is, also, a pregnant fact, worth mentioning, that the relative longitudes even of the Greenwich and Paris observatories have been recently changed.

"But the uncertainties arising from the intrinsic difficulty of making absolute determinations of longitude increase as the place is more remote, and therefore less known or cared for. The assumption of a new origin of longitude situated in this country will, to a considerable extent, remove these uncertainties, and save us from those fluctuations in our geographical positions to which we are now subject. In the magnetic telegraph, we have a means of determining differences of meridians, which belongs to the highest order of accuracy. It can be applied at once wherever the wires now run. An American prime meridian being adopted, this should be done as soon as possible. As the use of the telegraph is extended, the interior, throughout its whole space, would be connected in this manner with the stations of the Coast Survey and the National Observatory, and would have the geographical positions of its chief cities and county towns permanently and unalterably fixed, and thus the foundation would be laid of a correct geographical map of the whole country.

"In view of these considerations, it is proposed to establish an arbitrary meridian at the city of New Orleans, in some locality having a

difference of exactly six hours in time, or ninety degrees in space, from the meridian of Greenwich. These round numbers are easy in their use and application. They can be taken from or added to the headings of charts, the readings of chronometers, or the values in the astronomical ephemeris, without delay, and with little danger of mistake. The selection of the meridian of Washington, which, as the capital of the country, it will first occur to us to select, would be unsuitable, as the difference between it and the meridian of Greenwich is an inconvenient sum to add or subtract. The meridian of New Orleans cuts the great valley of the West, and approaches the central line of our territory on this side of the Rocky Mountains. It has also the practical recommendation, that between the American and English meridians, the degrees and minutes on the chart will be the complements of each other."

This communication of Mr. Davis was referred by the Association to a committee of mathematical gentlemen, from various parts of the Union, for consideration and report.

THE LONGITUDE OF BOSTON.

It will be noticed, that, in his paper on the American Prime Meridian, Lieutenant Davis states that, though the longitude of Boston west from Greenwich is better known than that of any other place on this side of the Atlantic, yet after the lapse of a hundred years, during which observations have been continually going on, there is a probable error of two seconds in the comparative longitude of that place. For some months, however, another means of determining our longitude has been in operation, and it is hoped that, in the course of a year, the longitude of Cambridge, and therefore of any other place in America, west from Greenwich, will be very accurately ascertained. Since the spring of 1849, forty chronometers have been carried to and fro from Greenwich to Cambridge, by every Cunard steamer, and the mean of the variations of the chronometers for each trip being taken, and then the mean for all the trips, it will evidently give the approximate longitude of Cambridge, by giving the difference between the time of the two places, which is easily converted into the difference of longitude.—*Editors.*

THE PLANET HYGEA.

M. Gasparis, of Naples, who discovered this planet on April 12, 1849, has furnished the following elements of its orbit, derived from several observations:—

Epoch, May 1, 1849.	° ′ ″
Mean anomaly, ...	326 34 22.44
Longitude of perihelion, ...	242 47 3.44
" node, ...	285 32 29.72
Inclination, ...	3 46 51.27
Mean daily motion, ...	590″.3784

This newly discovered planet belongs to the same group with *Astræa*, *Hebe*, *Iris*, *Flora*, and *Metis*, all of which are, as will be seen

below, of very recent discovery. The planets known from high antiquity are *Mercury*, *Venus*, *Earth*, *Mars*, *Jupiter*, and *Saturn*. To these, in 1781, was added *Uranus*, or *Herschel*, as it is sometimes called, from the name of its discoverer. Early in the present century, astronomers became convinced that a planet existed between Mars and Jupiter, and an association of twenty-four observers was formed to examine the whole heavens. But, early in January, 1801, the present planet *Ceres* was accidentally discovered by Piazzi, in Sicily. In March, 1802, *Pallas* was discovered by Olbers, in Bremen, and this was followed, in 1804, by the discovery of *Juno*, and, in 1807, by that of *Vesta*. On December 8, 1845, *Astræa* was discovered by Professor Hencke, and on July 1, 1847, he also discovered *Hebe*. *Iris* was discovered August 13, 1847, and *Flora*, October 18 of the same year, both by Mr. Hind. *Metis* was, we believe, discovered by Mr. Graham, in Ireland, on April 25, 1848. The recent extraordinary discovery of *Neptune* is familiar to all. The total number of primary planets discovered, up to the present time, is, it will be seen, 18. Many of them are never visible to the naked eye.—*Editors.*

INTERESTING ANALOGY IN BOTANY AND ASTRONOMY.

Prof. Peirce described to the American Association a curious analogy, which has been more fully developed by the Rev. Thomas Hill, of Waltham, Mass., in a recent review. "If, on any twig of a cherry-tree, we count the leaves from the bottom upwards, we shall find that the sixth leaf is over the first, the seventh over the second, &c. That is, two successive leaves, viewed from above, make an angle with each other equal to two fifths of a circle, and it requires five such intervals to make two complete revolutions. On a twig of the elm, the third leaf is over the first; or the angle between two successive leaves, viewed from above, is half a circle. In the currant, the angle is usually three eighths; that is, eight leaves are required to make three turns, and the ninth leaf is over the first. The angle which two successive leaves, viewed from above, make with each other, in any plant, is generally found to be one of the following series of fractions of a circumference:—$\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, $\frac{13}{34}$, $\frac{21}{55}$, $\frac{34}{89}$, &c. Sometimes, however, this angle is one of the following:—$\frac{1}{4}$, $\frac{1}{5}$, $\frac{2}{9}$, $\frac{3}{14}$, &c.; and occasionally we have found, in the golden-rod, fractions of the series $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{7}$ $\frac{3}{11}$, &c. Other fractions are found, but we believe that, in a healthy plant, the fractions always belong to a similar series,—that is, to a series in which *the two first fractions have the numerators each* 1, *and the denominators differing by* 1, *and the terms of any other fraction are formed by adding those of the two preceding*. Such a series, the higher it is carried, approximates more and more nearly to an aliquot part of the difference between the square root of five and some odd number. Now, if we divide the year of the planet Uranus by that of Neptune, the year of Saturn by that of Uranus, that of Jupiter by that of Saturn, &c., we shall obtain nearly the following fractions:—$\frac{1}{2}$, $\frac{107}{305}$, $\frac{21}{52}$, $\frac{39}{95}$, $\frac{53}{131}$, $\frac{17}{32}$, $\frac{8}{13}$, $\frac{22}{57}$. The close coincidence of these

fractions with the successive approximations of the common series for leaves is rendered still more significant by the fact, that one of those two which differs most from the common series, namely, the ratio between the year of Venus and that of the Earth, is one of a series which, in vegetable life, cannot be distinguished from the common, except by the spiral running in the opposite direction; the series, namely, beginning with $\frac{1}{1}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{5}{8}$, $\frac{8}{13}$, &c. The year of Venus differs by only about one hour and a half from $\frac{8}{13}$ of the Earth's.

"Among the periods of Jupiter's moons, also, we find three ratios, among those of Saturn six, among those of Herschel four, which are nearly approximations in these series. They do not, however, follow the proper order of approximation as they approach the primary planet.

"Here, then, are two problems, one in astronomy, the other in botany, and both solved by the same arithmetical law. The botanical problem is, to distribute the leaves, buds, petals, &c. of plants in such wise as to secure a graceful variety of symmetry. The astronomical problem is, to proportion the years of the planets in such wise as to render the conjunction of any considerable number a rare occurrence; to secure, that is, the system from too great mutual interference, by keeping the planets scattered round the sun. This is done by making the years incommensurable, and nearly in the ratio which is measured by approximations to an aliquot part of the difference between some odd number and the square root of five. The botanical problem is solved by setting the leaves at an angle, which is to the whole circle in a ratio measured by the same approximations. And, in both cases, the odd number usually employed is three, and the aliquot part is one half. The ratio between the Earth's year and that of Mars does not conform to this rule."

SECOND COMET OF 1849.

It now appears that the telescopic comet discovered in April, 1849, by Geo. P. Bond, of the Cambridge (Mass.) Observatory, was detected the same night by M. Schweizer, of Moscow. Its elements agree quite well with those of the second comet of 1748, so that it may be another instance of the return of a comet after a lapse of a certain period.

CONNECTION OF COMETS WITH THE SOLAR SYSTEM.

The following is an abstract of a paper presented to the American Association, by Prof. Peirce, on the connection of comets with the solar system. Prof. Peirce stated that there had been a century of exact observations upon comets, so that it seemed worth while to inquire if we could not now ascertain whether they are component parts of the solar system, or strangers visiting us from other systems. He believed that the facts were sufficient to decide this question.

If any form of the nebular hypothesis was to be adopted, it was necessary to consider their origin. Upon that theory, the readiest way to account for their existence would be to suppose them strangers to all systems, being produced from portions of the nebulous fluid left between the spheres of stellar attraction. His own opinion was, however, that they are component parts of our system, and that the comets within every system belong to that system.

There were two classes of arguments which might be produced. The first arising from the nature of their orbits,—from their not being hyperbolical. Of the hundred comets which had been carefully observed, and whose orbits had been accurately computed during the last century, not one had been shown to have a decidedly hyperbolical orbit. But if the comets do not belong to our system, one half of them, upon the average, ought to move in orbits decidedly hyperbolical. He came to this conclusion upon the ground that our system is moving in space. The very point towards which we are moving had been determined, and very recently, in a paper upon stellar astronomy, by Struve, the deduction had been given of the very amount of the motion of this system in space. Its velocity was computed as about one fourth of the velocity of the earth's motion in its orbit. It would amount to the same thing, to suppose the solar system to be placed in a stream of stars to which the comets belong, and the average velocity of which the comets would possess. Now, by the laws of motion, if the comet came into the solar system with no velocity at all, its orbit would be a parabola; but if its velocity was sensible, it would move in a hyperbola, the form of which would be exactly dependent upon the amount of this velocity. It had been shown by Laplace, that the direction does not influence the character of the form of the orbit, but that from the velocity alone, at a given distance from the sun, it can be determined. But if the comets did not belong to the solar system, there ought to be some of them with very remarkable hyperbolical eccentricity; so that the fact that there are no comets with hyperbolic orbits seemed to be in itself almost decisive proof that they do belong to the solar system. Another effect of this motion in space would be, that the comets would more frequently enter the system upon that side towards which we are moving; which was not found to be the case.

Prof. Peirce then showed, that, according to the doctrine of chances by Laplace, the chance was 71 to 1 that there was an actual law regulating the distribution of comets, and that they really belong to the solar system. A question would then occur, How are the comets connected with the nebular hypothesis? If a comet had been sent out from the sun by expansion, when it came back it could hardly escape from falling again into the sun, even if thrown tangentially. If sent off from the planets,—and Lagrange had found the necessary force to be comparatively small,—the inclination and direction of the orbits would be about what they actually are: with a tendency towards the plane of the ecliptic, and towards direct motion. The great difficulty was in making the force exactly sufficient to produce the parabola, or lengthened ellipse; for if it was more than this,

however minute the excess, they would pass from the system. Leverrier has shown that the action of Jupiter upon Lexell's comet had changed its orbit into the hyperbolic form. So, with this excess of motion, they would pass into another system, and thus pass from system to system, until they would pass so near some planet as to have their orbit reduced to the parabola or ellipse.

One remark with regard to the direction from which they come. Out of 90 direct comets, there were 57 which came from the south, and 33 from the north. The retrograde comets were nearly in the same proportion. Out of 94, there were 55 from the south, and 39 from the north. This difference, however, might simply be the accident of observation.

AMERICAN NAUTICAL ALMANAC.

Congress at its last session passed an act authorizing the preparation of a Nautical Almanac, and appropriating $6,000 to commence the work. Lieut. Charles H. Davis was appointed, by the Secretary of the Navy, to take charge of it, and he entered upon his duties as soon as possible. The office is at present situated in Cambridge, Mass., but it will probably soon be removed to Washington. We learn from the report of the Secretary of the Navy, that Lieut. Davis asks for an appropriation of $13,000 to defray the expenses of the work during the ensuing year; this sum will enable him to enlarge considerably the present corps of computers. Lieut. D. has, we are informed, secured the valuable services of Prof. Peirce, of Harvard University, whose acknowledged ability as a man of science, and world-wide reputation as a mathematician, cannot fail to inspire increased confidence in the correctness of the work. Two such men as Lieut. Davis and Prof. Peirce cannot fail to produce a valuable volume. The theory of Mars is now in progress. In the first number, which, on account of the immense amount of labor to be performed, cannot be published till about 1852, the ephemerides of some of the planets will be based upon new theories, which will make them much more reliable than any heretofore published.—*Editors.*

ASTRONOMICAL JOURNAL.

The American Association, at its meeting at Cambridge, voted that a journal is needed in this country, to be devoted especially to recording the results obtained by our astronomers, and they referred the subject to a committee, who drew up a prospectus. They say,—"An Astronomical Journal for the publication of original researches has long been needed in the United States, and the want is growing more urgent every day. American astronomy demands an organ, in which important investigations and observations may be published without delay, and which may serve especially as a magazine for astronomical researches made in this country, as a vehicle of information concerning the labors of individuals, and as an exponent of the general progress of science." They

then propose as their model the *Astronomische Nachrichten* of Prof. Schumacher, and state that "the plan of the proposed journal contemplates, not only researches in every department of physical, theoretical, and practical astronomy, but also investigations on all subjects directly connected with these, such as pure mathematics, geodesy, the theory of instruments, &c." The numbers are to appear at irregular intervals, as matter accumulates, or important information is received, and, when necessary, circulars will be issued. A volume will contain 24 sheets in quarto, and the subscription is $5.00 the volume. Mr. B. A. Gould, Jr., is the editor, and expects no remuneration.

Within a few weeks after the issue of the prospectus, the requisite funds were procured, and numbers were published on November 2d, December 13th, and January 7th. This is one of the most important steps that has been taken in science in this country for a long while, and as the Journal starts under so prosperous auspices, there can be little doubt that it will accomplish much good.—*Editors.*

METEOROLOGICAL OBSERVATIONS.

Among the most important investigations of our own time, we must assign a prominent place to those connected with meteorology. We may reasonably expect, within a comparatively short period, to ascertain the laws by which atmospheric phenomena, hitherto regarded as the emblem of inconstancy, are regulated. Observations of the most accurate kind are now made at all the magnetic and astronomical observatories in every part of the world. Among the most celebrated observers is Prof. Dove, of Berlin, Prussia, who has undertaken a reduction and full examination of all the meteorological observations that have been published heretofore in the different countries of Europe, and other parts of the civilized world. In a series of memoirs presented to the Academy of Sciences at Berlin, this investigator has most industriously determined the progression of atmospheric temperature during an interval of 115 years,—from 1729 to 1843. It is impossible for us to give any idea of the amount of labor of the most severe description which is bestowed on this examination,—of the great variety of interesting facts embraced in these memoirs. It must suffice to state, that the gradual passage of the *isothermal lines* of January and July into one another exhibits over the century the utmost regularity.

In the United States, a plan has been formed by the officers of the Smithsonian Institute for carrying out a grand series of meteorological observations, extending over the whole country, from the Atlantic to the Pacific, with a view of elucidating the phenomena of American storms. It is proposed to establish three classes of observers: one class, without instruments, to observe the face of the sky, as to its clearness, the extent of cloud, the direction and force of wind, the beginning and end of rain, snow, &c.; a second class, furnished with thermometers, who, besides making the observations above mentioned, will record variations of temperature; the third class, fur-

nished with full sets of instruments, will observe all the elements at present deemed important in the science of meteorology. As a beginning of this extended system, six sets of instruments have been forwarded by the Smithsonian Institute to the coasts of Oregon and California, and others to Bent's Fort and Santa Fé, New Mexico. As a part of this system, it is proposed to employ the magnetic telegraph in the investigation of atmospherical phenomena. By this means, not only the notice of the approach of a storm may be given to distant observers, but also attention may be directed to particular phenomena, which can only be properly studied by the simultaneous observations of persons widely separated from each other. Also, by the same means, a single observatory, at which constant observations are made during the whole 24 hours, may give notice to all persons along the telegraph lines of the occurrence of interesting meteorological phenomena, and thus simultaneous observations be made.

Many of these observations have already been commenced, and the telegraph companies from Maine to New Orleans have promised their aid in communicating the approach of storms, &c. In the State of New York, the Regents of the University of New York, generously aided by the Legislature, have organized a system of observations extending over the whole State. Prof. Guyot, late of Neufchatel, Switzerland, and author of "The Earth and Man," has been intrusted with the superintendence and direction of the work.

At the Lawrence Scientific School, Cambridge, Mass., a most interesting series of experiments and observations on the constitution of the atmosphere is going on, under the direction of Prof. Horsford and Prof. Guyot. The result of these observations, which have not yet been wholly made public, reveals some important facts relative to the presence of moisture, ammonia, carbonic acid, and organic matters in the atmosphere, and their connection with other phenomena.

It is a mighty problem, whether human ingenuity cannot so far discover or foretell the approach of storms, as in some measure to prevent the fearful loss of life and property with which they are usually accompanied. The regularity of the alterations of the temperature, when accurately ascertained in various parts of the country, may be applied with advantage to the labors of the husbandman in the introduction of new articles of culture, and in the improvement of agricultural processes. A proper study of climate, also, as to its heat and cold, dryness and moisture, and all its other incidents, can alone furnish us with safe data by means of which we can ever hope to eradicate epidemic and endemic diseases, or, at least, mitigate their severity.

AURORA BOREALIS, NOVEMBER 17TH, 1848.

The display of the aurora borealis on the night of the 17th of November, 1848, was probably as wide-spread as any to be found on record, and in respect to the brilliancy of the display it has rarely, if ever, been surpassed in the northern portions of our country. At one time, as observed in Western New York, a circular spot south of the zenith was the only part of the heavens destitute of the aurora, and

for nearly two hours this continued to be the case, the rays, or streamers, running from the southern as well as the northern horizon to this spot. At Principe, in Cuba, latitude 21° north, it was remarkably brilliant in the northeast, for several hours, an extremely rare phenomenon in that latitude. In Asia Minor, at Smyrna, Salonica, and Odessa, and in Upper California, longitude 122° west, latitude 37° 37′ north, the aurora attracted unusual attention. In the latter place it was the first display that had ever been noticed by an individual who had resided for a considerable period in the country. In various parts of England and Scotland the exhibition is represented to have been of extraordinary magnificence.

BAROMETRIC VARIATIONS IN INDIA.

The *Bombay Times* contains an interesting article on the barometric variations, as observed at Bombay, Madras, and Calcutta, which shows that the greatest pressure for all parts of India occurs between the 15th and 22d of January, and gradually diminishes until June, when it reaches its minimum. The following are the mean maxima and minima for coincident periods:—

	Jan.	June.
Madras, ...	29.998	29.668
Bombay, ...	29.944	29.633
Calcutta, ...	29.962	29.506
Aden, ...	29.915	29.606

On the 5th of February and the two following days, the barometer at the first three localities indicated the extraordinary mean pressure of 30.200 inches.

BLACK RAIN IN IRELAND.

On the 14th of May, a shower of black rain fell in several parts of Ireland. It was particularly noticed at Carlow, Kilkenny, and Abbeyleix, and is supposed to have extended over an area of more than four hundred square miles. It occurred about six o'clock in the evening, and was preceded by such extreme darkness, that it was impossible to read except by candlelight. After this darkness had existed for some time, a hail-storm, attended with vivid lightning, but without thunder, occurred, and when this subsided, the black rain fell. This rain was found on examination to have an extremely fetid smell and a disagreeable taste; it left a stain upon some clothes on which it had fallen, and the cattle refused to drink of it. A bottle of this rain has been presented to the Royal Dublin Society by Prof. Barker. The specimen had been sent to him from Carlow, accompanied by a letter, in which the writer mentioned that at the time of its collection it was uniformly black, and resembled writing-ink. Prof. Barker had found, that, by allowing it to stand for a time, the black coloring matter separated from the water with which it had been mixed, rendering the color of the rain much lighter than at first.

ATMOSPHERIC ELECTRICITY.

M. Quetelet, Secretary of the Royal Academy of Sciences of Belgium, has recently communicated to that institution several important particulars connected with some anomalous conditions observed in the electricity of the atmosphere during the present year. Usually the atmospheric electricity is, in that country, of the highest intensity in January, and reaches its minimum in June. The values for these months are in the relation of 32 to 1 when the sky is perfectly serene, and of 8 to 1 when it is clouded. During the whole of last January, the electricity was constantly less than in any previous year observed, being below one half of its ordinary intensity. This diminished intensity has been observed up to September, the minimum being extended beyond the ordinary period.

PROGNOSTICATIONS OF THE WEATHER.

An English gentleman, Mr. E. J. Lowe, has recently published the results of a multitude of meteorological observations, undertaken with a view of ascertaining whether the popular and generally received opinions respecting atmospherical phenomena have in reality any foundation. The conclusions are, that little or no dependence can be placed upon any of the popular signs or prophecies, and that, in most cases, fair weather predominates even when the prognostications indicate rain. The following table of numerous registered observations on phenomena which are said to indicate either rain or fair weather, shows how the result stood.

	No. of Observations.	Followed in 24h. by Fair	or Rain.
Solar halos	204	133	71
Lunar halos	102	51	51
White stratus in valley	229	201	28
Distance clear	102	61	41
Distant sounds heard as if near at hand	45	25	20
Aurora borealis	76	49	27
Colored clouds at sunset	35	26	9
Dew profuse	241	198	43
White frost	73	59	14
Stars bright	83	64	19
Stars dim	54	32	22
Smoke rising perpendicularly	6	5	1
Sun red and shorn of rays	34	31	3
Moon shining dimly	18	12	6
Flies troublesome	22	12	10
Spiders' webs thickly woven on the grass	13	9	4
Leaves of vegetables drooping	25	5	20

THE CLIMATE OF ITALY.

M. Dureau de la Malle concludes a recent series of elaborate investigations into the climate of ancient and modern Italy, the re-

sults of which he has presented to the French Academy, with the observation, that the limits for different agricultural products were the same in the early as in the more recent periods; and that, from the time of Augustus till now, there has been no sensible modification of temperature either as regards the months or the years.

WATERSPOUT.

A WATERSPOUT of great size occurred on Thursday, the 2d of August, in Chattanooga county, Georgia. It is reported to have made an impression in the earth thirty feet deep and forty or fifty feet wide. Forest-trees of great size were torn up by the roots, and rocks weighing several thousand pounds were removed to a considerable distance. It is but a short time since one of these phenomena of nature occurred near the same place, at what is called Stephens Gap; it made a singular hole in the ground about three feet deep and eighteen or twenty feet in diameter, the sides of which are perfectly perpendicular, and as smooth as they could be made with a spade.

OBSERVATIONS ON THE SATELLITE OF NEPTUNE.

THE following observations on the satellite of Neptune, made at the Cambridge Observatory, have been communicated to the American Academy, by the director, Mr. Bond:—The light of the satellite we have found to be nearly equivalent to that of a star of the fourteenth magnitude, as stars of that class, brought as near to Neptune as is its satellite, about equal the latter in faintness. The elements of the satellite's orbit, as computed from five measurements taken near the times of its greatest elongation, are:—Periodic time, 5.8752 days. Inclination 30°. Ascending node, 300° if the motion be direct. Mean distance, 16.″3 at the mean distance of Neptune.

Under good definition, Neptune shows a round disk, distinguishing it from stars of the same brightness. Its color is bluish, resembling the light of Uranus. There has been noticed more than once an appearance somewhat of the nature of that from which Mr. Lassel has inferred the existence of a ring; but whether it is caused by a ring, or by the inner satellites which probably exist, or whether it be only an optical appendage, it would be difficult to determine.

GEOGRAPHY AND ANTIQUITIES.

ON THE PROGRESS OF THE SURVEY OF THE COAST OF THE UNITED STATES.

At the recent meeting of the American Association, Prof. A. D. Bache, the Superintendent of the Coast Survey, gave an account of its progress. "The survey of the coast was first proposed by Mr. Jefferson, in 1807. Congress acted upon the subject but tardily. The Executive was even more tardy after the law had been passed. At that time the importance of the work was hardly understood. The work was greatly in advance of the times. Mr. Gallatin sketched the plan of a magnificent geodetic work; one which, embracing the survey of the coast of the United States, should connect with it a survey on the water of all the approaches to that coast.

"In 1816 the work was commenced, under the direction of Mr. Hassler; but in 1818, from the idea that he was proceeding too slowly, the work was stopped. It was revived in 1832, and he seemed then to have more enlarged ideas of what the work might be made, for his second series of observations were on a larger scale than the first. His instruments for measuring horizontal angles are even now quite as good as any used abroad. In 1844, when he was proceeding rapidly, his labors were closed by death. The year 1844 was with me a year of observation. I examined the complaints of the slowness with which the works were going on, and concluded that, if it was to be pushed much more rapidly, more money must be granted. Still, I thought the work might be in some way or other expedited, as I had the advantage of beginning with a foundation already laid, and with trained assistants. Mr. Hassler intended to begin at New York, and extend the work north and south from that point, working at both ends. I concluded to divide this into smaller sections, so that we might extend the work from several centres. The question of the manner of making the division depended upon the then progress of the work itself, and the manner of operation. The plan of operations in the coast survey is briefly this:—First, a base line is measured by the most accurate means we can devise; say a line of from 6 to 10 miles in length. We have some bases as small as 6 miles; and we

have one upwards of 10 miles in length. Having established the length of this base, a series of triangles is adopted, of gradually increasing sides, the lengths of which, or distances between the angular points, are known from the base and measured angles. By measuring the angles from the extremities of the base, the length of which is exactly known, we obtain the direction and distance of a new point, and thus a new base line. That line, in turn, establishes another at a still greater distance; and thus the surface of the earth is covered with a network of triangles, each side of each triangle being calculable from the measure of the angles, and from the length of the originally determined base. This would be easy, were the triangulation upon a plain surface; but the calculation is not so simple as it would at first appear. The earth must be considered, in computing these large triangles, not merely as a sphere, but as a spheroid. Next comes the astronomical part of the survey. The direction of the lines with reference to the meridian must be known. The latitude of the points must be ascertained, and their longitude must be determined. Having these data, we then know from computation the latitude and longitude of any point, and the angle with the meridian of any line connected with the triangulation. This is the second part of the work.

"We have thus a great scheme, in which the progress may be very rapid, because the steps may be very great. You may have—as we have in some cases in our New England triangles—a side of 60, 90, or even 100 miles in extent; and thus you may make vast strides along the coast at once, by taking advantage of hills properly situated in the interior of the country and overlooking the ocean shore. Having determined these points with great nicety, with large instruments, and a great deal of care, the work between them need not be done so elaborately. New points are determined between the former, upon the same great system of triangulations, called the secondary triangulations. Upon this, with a still less exact mode of working,—namely, with the plane table,—the topography is laid down so far as it may be necessary to show the coast to the navigator, and for purposes of defence. All the points are checked by the secondary triangulations, which in their turn are checked by the primary; so that, having taken great pains in the first part of the work, you cannot wander far out of the way in the second part, or in the topography. Having thus determined the outline of the coast, the hydrography gives you a picture of the sea, just such as the topography gives you of the land above its surface, and this completes the survey.

"Originally, I divided the survey into eight sections. Texas made a ninth, and Oregon adds a tenth section. In the first section, from Point Judith to the boundary, we have now finished the primary triangulations, from the base on the Boston and Providence Railroad, along the coast of Rhode Island, Massachusetts, and New Hampshire, into Maine. The hills of New England seem as if they had been made for triangulation. They are so situated that we can pass rapidly along the coast with long strides; and the only difficulty is to avoid being tempted to make the lines too long. I have frequently, however, in taking such long lines, taken also an intermediate shorter line, for the

purpose of verification. We have then passed, in five years, on the primary triangulation, from Rhode Island to Maine; and it could have been done in three years, had it been desirable so to occupy the time.

"The secondary triangulation has extended along the coast, determining the positions of points near the coast, around the peninsula of Cape Cod to Cape Ann. There are now two parties at work upon this step in the process; one passing from Cape Ann to Newburyport, and the other from Newburyport to Portsmouth; so that by the end of the season we shall have reached nearly to Saco, in Maine, with our secondary triangulation.

"The topography has been carried regularly forward in the same way, with but one exception, in which I have perhaps taken some responsibility. I certainly did have Boston Harbor surveyed two years before it would have been done in the regular course. But then I had a very violent motive for this; namely, an appropriation made by the State of Massachusetts to hasten the survey of the coast,—an act of liberality which has never been imitated by any other State in the Union. We have two large manuscript maps of Boston Harbor, which you will see in the State-House, in the month of October next, of a very finished character. Thus, in six years (adding the present year), at this end of the work, we have advanced from Point Judith, with the primary triangulation, to Portland; with the secondary, beyond Portsmouth; and with the topography, to Gloucester.

"The hydrographers have had a long and difficult piece of work in this section. They have had those famous Nantucket Shoals to stop them. But if the survey had rendered no other benefit to the country than making known the before unknown and hidden dangers of that part of the coast, it certainly would have repaid to the country, in money, the whole amount which it has cost. One vessel which came very near stranding upon shoals—now, through the enterprise of Lieut. Davis, made known and familiar to us—had a cargo which paid the government a duty of $125,000; and if this sum had been devoted to the survey, the shoal would have been discovered years ago. Lieut. Davis's discoveries consist of an important shoal outside of the Old South Shoal of Nantucket, lying right in the track of vessels from New York to Europe, and returning, and of vessels passing from the New England States to the Southern States and South America. The hydrography has been extended up Buzzard's Bay through Nantucket Sound, through the Vineyard Sound, has embraced the Nantucket Shoals, and has included the hydrography of Boston Harbor, of which an accurate chart has been made. The results of the survey pass through a regular process, from the time the observations are made in the field to the time the map is produced in the office. The assistants, who make the observations, report them, and compute them. Other computers also pass over the same calculations. The results are brought into juxtaposition and compared. If they agree, they are considered as correct. If they disagree, the cause is carefully examined, and the error corrected. The results, thus verified, are placed upon paper in the ordinary forms of projection of maps. They are next engraved, as fast as we can find hands

to engrave them; and when engraved they are made public. We have published, within the five years past, twenty-five sheets of maps of a very finished kind. They have been examined by our own citizens, and by foreigners; and I believe with approval in every case. I have carefully compared them with foreign maps, in order to see where we stood, and what we had to learn. The arrangements for this part of the work are not now quite adequate to the demand of the field-work. The number of computers, draughtsmen, and engravers requires to be increased. It is almost impossible to get a good map-engraver to come to Washington, as all are employed at home.

"It is easy to see when the first section of the work may be finished. There are about sixteen stations to the boundary, which could be occupied in two years and a half, at the present rate, making the astronomical observations as well as the geodetic. I do not propose to do so, because my time in the spring and autumn is better employed in other positions, and it would be better, therefore, to occupy two stations in the north in a year, than to occupy six or eight, as I have done when it was necessary, in order to get ahead of the other operations of the survey. So much for the first section.

"The second section is done, excepting the work of verification and making necessary changes. There was a rich harvest of hydrography in Long Island Sound,—discoveries of detached rocks, about which little had been said. But in the case of the entrance to New York Harbor, there was a richer harvest; for there Capt. Gedney found a new channel, now called by his name. This was either a new channel, or a channel which has long existed, but which was newly discovered; most probably the latter, and that in the progress of the hydrography of the coast survey. The advantages of a channel having two feet more of water in it than the main ship-channel will be appreciated by all. Buoys have been placed in it, and it is easy to find the way out and in.

"I was told last year that it was filling up; which is not true. It is often remarked, that the coast is changing every year, and there is, therefore, little use of surveying it. The truth is, that there are a few points in which the coast is really changing, and those points should be carefully watched. We should know where they are, and why they are changing, and how to stop the changes if it is necessary, and how to avail ourselves of them if it is necessary. But in New York Harbor it was the easiest thing in the world, at a trifling cost, to have the hydrography repeated, and the result showed that there are not six inches more or less of water than there were when the survey was made, so that the changes which have taken place in the harbor, if any, are exceedingly slight. And if we consider the nature of the operation of sounding, I should say that there had been probably no change.

"The discovery or determination of three channels in Delaware Bay rewarded the exertions of the officers engaged there,—Capt. Gedney and Lieut. Davis. These channels are not of so much interest as the channel into New York Harbor; but they are of very great importance. One of them is now constantly used by vessels

carrying coal from Philadelphia to the eastern parts of the Union; buoys having been placed in it, so that it is known. Another one enables vessels to pass directly across to the breakwater, when lying in Cape May Roads, the wind comes out at northwest, exposing them to the dangers of a lee-shore. This section of the work (the second), then, I consider as completed, with the exception of a portion of the work of verification.

"Mr. Hassler did not at once publish his results, and I have aimed to bring up all the back-work, and then to keep the publication abreast of the work itself. This I have nearly been able to effect. The third section extends from the capes of the Delaware to the capes of the Chesapeake, and includes the States of Maryland, Virginia, and a part of Delaware. The primary triangulation has been carried down the Chesapeake into Virginia, and I have very little doubt, from the report of the assistant who had charge of that part of the work, that the triangulations will, this season, reach the James River. The secondary triangulation already extends, both in the Chesapeake Bay and on the ocean shores, into Virginia. The fourth section embraces the State of North Carolina. The primary triangulation has been carried, from the base measured on Bodies Island, up the Albemarle Sound, into Pamlico Sound, and the sheet of water which, under the various names of Roanoke Sound, Currituck Sound, &c., fills the space between the sandy part of the coast of North Carolina and the swamp which immediately joins it,—those sounds constituting the great line of communication between the North and South, through the Dismal Swamp Canal from the Chesapeake Bay into Albemarle Sound.

"It is very remarkable that natural causes should tend to counteract natural difficulties. Such a change in the direction of the currents has taken place near Cape Hatteras since 1846, that the point of the cape has begun to make out, and thus affords a natural protection, behind which there is a beautiful cove, easy of entrance, with a capital anchorage, and perfectly protected from the sea in a northeast wind. Hatteras Inlet affords a beautiful harbor of refuge to the extensive coasting trade passing from the South to the North, and from the North to the South, in the United States. Now we can only approximately estimate when this section will be done. The reconnoissance was only made in 1843, and the triangulation commenced in 1845. But the period of survey, from the beginning to the end, cannot exceed twelve years, and three of these have passed.

"The next section is a very interesting one, along the coast of South Carolina and Georgia. It is a curious, but a uniform fact, that the coast of the United States in general lends itself to this kind of work. Where it is not made up of the bluffs which we have in New England, with the noble hills in the interior, there is generally a sandy island or a continuous beach of sand, or a hillock, or a piece of morass within which there is very deep water, forming an internal navigation, and across which the lines are readily run, affording an opportunity exactly for this work. What could be better than Albemarle and Pamlico Sound on the flat coast of North Carolina? In South

Carolina, the difficulties seemed to accumulate; the wide bays, separated from the ocean by a narrow strip of land, disappear; but, nevertheless, a scheme of triangles has been found perfectly practicable, and a part of them have actually been traced upon the surface of the ground itself. The triangulation and topography of Charleston Harbor are finished, and the astronomical determinations made.

"We have not materials for computing the date when this section will be finished, but we can give a very fair estimate of it from what we know by the reconnoissance, and limit the time for the land operations to two or three years. I have not supposed that we could undertake more than six sections out of the eight unfinished on the Atlantic and Gulf of Mexico. When any one was entirely finished, I could take up a new section. Last year, by the wise liberality of Congress, an additional appropriation was given for the Florida coast, which has enabled me to begin another section. This is that important part of the coast embracing what is called the Florida Reef and Keys, consisting of the dangerous reef and of the chain of islands running westward from Key Biscayne, and ending in the Tortugas. The reconnoissance of this chain of islands has been nearly completed.

"In section seventh, the reconnoissance has been made from Mobile Bay towards the east, to include Pensacola Bay, connecting the work with the base line measured on Dauphin Island in Alabama.

"Section eighth is an interesting one, including as it does the highway between two most important points in the Southern country,—Mobile and New Orleans. It includes the coast of Alabama, Mississippi, and part of Louisiana. Here the progress of the work has been very considerable. It was commenced in 1845, by a reconnoissance, and followed up, the next year, by triangulation, the measurement of a base, and the astronomical observations connecting the stations. Now we have completed the triangulation from Mobile as far as Lake Borgne, east of New Orleans. Another year we shall finish the triangulation to New Orleans. The topography has kept pace with the triangulations; and the hydrography, also, has very nearly kept pace with them. Here we have not been without our reward, any more than in the other sections, in usefulness, as the authorities of Mobile have testified. The bar of Mobile Bay is actually deepening, and vessels can now carry twenty-one feet of water over it into the bay. As a result of this discovery, the British steamers now come into Mobile Bay, and have even found more water than we had marked, by coming in at a time when the wind had heaped up the water in the bay.

"Section ninth, including Texas, has been generally examined from one end to the other, and more particularly near Galveston. The primary triangulations have been commenced in the neighborhood of Galveston, and the secondary triangulation is nearly or quite completed in Galveston and Anahuac Bays. The topography will be commenced in the autumn, and the hydrography will at once follow upon that. The astronomical observations necessary have been made. What progress the Oregon and California sections may show, we can

only tell when the California gold mines are a little exhausted. Two parties have been sent to Oregon Territory.

"As the triangulations on the Atlantic and Gulf coasts are extended from their bases, they will meet, forming a connected geodetic work, and the bases which now serve as the groundwork of the operations will then serve as bases of verification; the work in each section, meanwhile, being adequate to furnishing preliminary maps and charts for the use of navigators. Connected with this work has been a most important exploration of the Gulf Stream off our coast, from Cape Cod to Cape Hatteras.

"In connection with Lieut. Davis's proposal for an American prime meridian, it has been argued that it will destroy all our coast survey maps. But we took this meridian of New York as a temporary one; it was avowed temporary. The meridian of Greenwich is also marked upon our maps. But it is a matter of very little consequence indeed to us, whether the meridians have to be changed or not. After the map has been engraved, the next step is to copy it, by the electrotype process. A plate in relief is deposited upon the original, and upon this plate, thus produced, we can make any alterations we please. With a common scraper, we can scrape out these meridians; electrotype that again, and we can put in upon the new sheet any new lines we please. We do not use the original plates in printing our maps, because they soon deteriorate and wear out, so that very few impressions could be taken. We use, in general, the electrotype copies."

INTERIOR OF AUSTRALIA.

The interior of Australia, in spite of the numerous expeditions which have of late years been undertaken, yet remains a question to be discussed and set at rest by future travellers. The centre of that vast island, which some suppose to have been formed by an archipelago, and some to consist of a great belt of sand encircling an undiscovered sea, has given rise to more inquiry than perhaps any other recent geographical problem. The adventurous spirit of a Mungo Park might, perhaps, have unravelled this difficult question. We have no such travellers now. Few men would care to toil, alone and unprotected, through so savage a wilderness as that which the explorer must traverse, in order to penetrate the remoteness of Australia. The danger of the enterprise deters men from it; and perhaps the character of the country is less propitious to the adventurer, than even the wild solitudes of Africa. Scarcity of provisions and water, the risk of hostile collision with the natives, the inhospitable nature of the country,—these are dangers and obstacles which induce the explorer to set forth attended by a numerous company, and furnished with cumbrous wagons, and other means of conveyance. These obstruct the progress, while they increase the comfort of the traveller, but are, perhaps, unavoidable evils, when we consider the character of the little-known districts of the Australian continent.—*Edinburgh Magazine.*

SNOWY MOUNTAINS IN EASTERN AFRICA.

The following particulars respecting the snow-capped "*Kilima dja aro*," or "Mountain of Greatness," discovered by the Rev. Mr. Rebmann in Eastern Africa, within 4° south of the equator, will be perused with interest by all our readers. From Kilima, the farthest point to which he had advanced on his previous journey, Mr. Rebmann and his party proceeded in the direction of Madjame. For six or eight miles the path lay in a northwest direction over a gradually rising country. They then reached the northern limit of inhabited land, being about eighteen miles distant from the foot of the Jagga mountain. Here the cold was as great as in Northern Europe in November; this was not a matter of surprise, for they were so near *Kilima dja aro*, that it could be seen even by the light of the moon. On the next day they proceeded several miles in the same direction, until they entered a mountainous forest, when the path became due west, and continued so until they reached Madjame. Having completed about twelve miles, they entered Ura (Ooroo), a province of Jagga, which they found intersected with valleys from 1,500 to 2,000 feet in depth, through which ran perennial streams, supplied by the mountain snows. As they approached Madjame, they arrived at the fine river Weriweri flowing over a stone bed, in a valley about 150 feet deep, and 30 or 40 yards broad, the river at this season occupying about one third of the channel. Here fires were necessary. Crossing the river, they stopped for some time within three or four miles of the foot of the mountain, whose shape Mr. R. can, therefore, very accurately dsecribe. "There are two summits rising to the limit of snow out of the common mountain mass. The eastern is lower, and terminates in several peaks, the snow on which varies with the season. The western summit is the proper perpetual snow-mountain, and rises above its neighbor, and is formed like an immense dome. It is ten or twelve miles distant from the eastern summit, the intervening space presented a saddle which, it is believed, is never covered with snow. The natives call the snow *kibo*, and are well aware that it is nothing but water." This information sets at rest the question of the existence of snowy mountains almost under the line in Eastern Africa. The journey referred to was made about November of 1848; and on April 5, 1849, Mr. Rebmann set out on another journey towards the lake in Uniamesi.—*London Athenæum*, *Nov.*

THE FRENCH AFRICAN EXPLORING EXPEDITION.

On the 4th of March last, Capt. Boüet, who was in command of a French ship, succeeded in crossing the bar at the mouth of the Great Bassein River, situated on the western coast of Africa. The attempt was attended with great danger, and of the four officers Capt. Boüet lost three, and he was himself several times attacked with sickness; but he still persevered, and has been rewarded by the discovery of two magnificent lakes, on whose shores palm oil is so abundant that the ship had not vessels enough to hold it. Palm oil is said to afford

a profit of 80 per cent., so that a field is opened for persons of adventurous dispositions and great energy to reap a fine harvest in return for their labors. One important discovery made by Capt. Boüet is, that the Grand Bassein is, as has been conjectured by geographers, a confluent of the Niger. As it was the dry season, they could not explore the river as far as they wished, but in the rainy season there are six feet of water, and the river may then be ascended, it is said, 50 leagues, to the cataracts of Abouesson.—*London Athenæum, August.*

NEW RIVER IN CALIFORNIA.

THE *National Intelligencer* for Jan. 18, 1850, contains a letter from Major Emory, dated Aug. 20, 1849, from his camp, south of San Diego, in which he says:—

"A very remarkable circumstance has occurred in that portion of the country between the mouth of the Gila River and the mountains usually called the 'Desert,' sometimes the 'Jornada.' A river, forty feet wide and more than waist deep, has appeared in the middle of this desert, affording delicious water to drink, making an oasis at the most convenient spot for the traveller.

"The first parties that came in by the Gila route arrived in San Diego about the 20th of June. Amongst them were many intelligent persons, who passed over the route of the advanced guard of the Army of the West in 1846, and who saw no river in the desert, and suffered dreadfully with thirst. The parties that came in about the 4th of July first stated this remarkable circumstance of encountering a river where none before existed. But they were not duly credited. Others have since arrived in great numbers, all bearing testimony to the truth of the statement.

"From the best information I can gather it appears,—1. The event must have taken place between the 20th of June and 1st of July. 2. Its source is to the south of the route traced on my map. It crosses that route about midway of the desert, or, more correctly, about half way between the camp of the 26th and 27th of November, noted on the map, and its course is a little east of north.

"In connection with this subject, it may be stated that a fine fresh-water lake has also been formed a few miles to the south of the camp of November 26th. This is evidently from the back water of the Colorado, the indication of the barometer in 1846 showing it to be near the level of the Colorado.

"My first impressions were that the new river was furnished from the same source, and the barometric measurements of 1846 are not adverse to this supposition; but its direction nearly north, and other circumstances, seem to forbid this conjecture. It cannot be supplied from the mountains, which, in that parallel, and to the south, do not reach the regions of snow. Whence it comes, and where it goes, is a matter yet to be determined.

"The existence of water must soon be followed by the growth of grass; and, if the river continues, the route by the Gila, now much

travelled, will stand fair to rival all overland routes to California. It is, probably, the only route within the limits of the United States that can be passed in winter, and the one upon which will concentrate the winter travel to the Pacific.

ANCIENT MINING OPERATIONS ON LAKE SUPERIOR.

THE following remarks on the relics of ancient mining operations were made by Mr. Hodge, at the last meeting of the American Association. These relics, found near Lake Superior, consist of excavations along the line of the veins, and of numerous stone hammers scattered around them. Some copper tools have also been found in these excavations. The workings are scattered over the whole mining region, and extend even to Isle Royale. The pits are sunk to the depth of twelve or fifteen feet, even into the solid vein-stone, and have subsequently been filled with sand and gravel, and on this trees have grown which are more than 100 years old. The hammers are so abundant, that, at the Minesota mine, he was informed by the agent of the company that fifty cart-loads of them might be collected. They are made of a hard variety of trap-rock, and resemble in form the hammers or pestles found in New England. With these, and probably by the aid of fire, to render the rock brittle, the ancient miners penetrated into the solid vein-stone, and removed considerable masses of the metal. One of these, discovered in one of the pits at the Minesota mine, at the depth of twelve feet, which was abandoned by the old workmen, because it was too large for them to remove, was found to weigh over five tons, after being extracted and cut up. This had been perfectly cleaned from the vein-stone and all adhering rock before it was left. It had been partially raised up, and was found resting on charred skids of timber, which bore the marks of cutting instruments.

Mr. Hodge said that he could not agree with an opinion expressed by Dr. Jackson, that all these are the workings of Indians. This race have no use for copper, and there are no traditions of their having sought for it. In the researches of Messrs. Squier and Davis upon the Western mounds, they met with copper chisels, one of which was handed him for chemical examination, to determine, if possible, any indication it might bear of having come from the mines of native metal of Lake Superior. It gave no trace of silver, but was pure, soft copper, like much found in these regions. These workings and the mounds appeared to him to be productions of the same race, one more intelligent and skilful than the present race of Indians. The workings of the English companies, about the year 1670, are known, and, moreover, characterized by the remains of iron utensils, which have been found about them. Should any other relics, as the curiously carved figures of animals in the hard porphyry, or a single skull of one of the workmen, be found, this interesting question would be at once settled.

AMERICAN ANTIQUITIES.

SEVERAL specimens of American antiquities have recently been received in this city. They were discovered by an American traveller, while exploring the country of the Sierra Madre, near San Luis Potosi, Mexico, and excavated from the ruins of an ancient city, the existence of which is wholly unknown to the present inhabitants, either by tradition or history. They comprise two idols and a sacrificial basin, hewn from solid blocks of concrete sandstone, and are in the most perfect state of preservation. The largest of the idols was undoubtedly the god of sacrifice. It is of life size, and the only complete specimen of the kind that has been discovered and brought away from the country. The anatomical proportions and beauty of this statue are not admired at the present day, but the elaborate work upon its entire surface attracts attention at once. It is principally ornamental, interspersed with symbols of mythology, and occasional hieroglyphics. It has two faces, representing youth and old age; signifying that none are exempt from offering life as a sacrifice. The right hand forms an aperture, in which a light burned during the time of sacrifice. The smaller idol is the god of sorrow, to whom worshippers came to offer up their devotions for the tears it shed, and the relief afforded them in their griefs. This statue is diminutive, the carvings plain, and the whole simply devised. Their sacrificial basin measures two feet in diameter, and displays much skill and truth in the workmanship. It is held by two serpents intwined, with their heads reversed,—the symbol of eternity, which enters largely into the mythology of the ancient Egyptians. The Egyptian gallery of the British Museum contains several specimens of the work here described.—*New Orleans Paper.*

A MONUMENT OF THE ONEIDAS.

AT the ordinary monthly meeting of the National Institute, in June, a brief memoir was read by Mr. Schoolcraft, on the Oneida Stone, a curious and unique monument of the nationality of the Oneida tribe, in Western New York. This stone, of which Mr. S. presented a specimen, has imparted a name to the tribe, who call themselves the People of the Stone. Its chief interest arises from the ancient and intimate connection which this extraneous mass of rock has with the tribal origin, liberties, and security of this celebrated member of the Iroquois confederacy. The stone is a large and solitary boulder of sienite, totally different in character and appearance from the rocks of the vicinity, and nowhere occurring *in situ* nearer than the Adirondack Mountains of the Champlain country.

In late years the "White Stone" of the Oneidas has been frequently visited, and from the desire of possessing a specimen, it has been gradually wearing away under the hard knocks of the antiquary. In consequence of this, and in order to place it where it will be more accessible, this valuable relic has been removed to the cemetery of the city of Utica, where it will be carefully preserved from future depredations.

MEXICAN ANTIQUITIES.

LIEUT. SIMPSON, of the U. S. Topographical Engineers, has recently made a report to his bureau of a journey made by him with a body of troops from Santa Fé, *via* Santo Domingo, to Janez, thence northwesterly, through a hitherto unexplored region, to the mouth of the renowned cañon of Chaillé, from which point he returned, by Laguna, to Albuquerque and Santa Fé. The whole distance travelled, out and back, was 585 miles, occupying 40 days. During the march many interesting discoveries were made. Lieut. Simpson says:— "All along the route we met with objects of interest, but what excited our curiosity more than any thing else was a series of ruins in the cañon of Chacco, which, doubtless, from their locality, appearance, and numbers, are the veritable remains of the Aztecs of the twelfth century; the locality of which, on the authority of some of the maps, Humboldt has ascribed to the vicinage of the very spot where they were found. These ruins are of an exceedingly interesting character, both on account of the mechanical skill and taste which they exhibit, and of the undoubted evidence which they display of having been erected at a very remote period. The Indians of the present day know nothing of them, except that, according to tradition, they were once inhabited by a people which came from the North; that Montezuma was the governor of this people; and that, after living here for a period, they dispersed,—some eastwardly, towards the Rio Grande, and others southwardly, towards the city of Mexico.

"Each pueblo is a simple structure, covering, in some instances, as much as two acres in extent; indicating, in places, by the still standing walls, four stories, and containing as many as three and four hundred rooms. The main walls, which have plain surfaces throughout their whole extent on the exterior, are very nearly three feet thick at the base, and retreat on the inner side by a series of small jogs from bottom to the top, thus lessening the thickness gradually from the bottom upwards. The whole structure is built of a beautifully compact lamellar sandstone; the inner portion of this kind of stone and of clay mortar; and the outer portion faced with pieces of rectangular exactness, so thin that three inches may be considered as their maximum thickness, and three quarters of an inch their least. The general appearance of the face of the building, at a little distance off, is that of a magnificent piece of mosaic work.

"Another object of interest, which the expedition has enabled us to see, was the far-famed cañon of Chaillé, which has ever been regarded as the stronghold of the Navajoes, on account of the immense depth and inaccessibility of its walls, and the impregnable fort which it is said to contain. The idea of the *existence* of the fort we are now enabled to explode.

"A third object of interest which the expedition has brought to light is the existence of a rock of magnificent proportions and of fair surface, upon which were found inscribed, in some instances, in beautiful and deeply-engraven characters, the names of a number of persons, in connection with the dates of their passing by the locality, and some

other incidental allusions to occupation and history. One of these dates reaches back as far as 1606, and there are a number of others of this and the succeeding century. It is not at all improbable that these inscriptions may be found of value in the suggestion or establishment of some point or points of history, and as such are to be regarded with attention and interest. Fac-similes of all these inscriptions I have had taken, as well as drawings made of every important object of natural curiosity, and plans and drawings made of all the principal ruins which have come under our observation."

ANTIQUITIES IN CENTRAL AMERICA.

MR. SQUIER, our Minister to Central America, has been engaged in pursuing his antiquarian researches in that interesting country, though he has not as yet had time to make much progress. He writes:—"The Indians of Subtiava have dug up for me a number of their buried idols, and are now exhuming more. They impose but one condition, that I shall have no Spaniard with me when I go to see them, and shall keep the localities secret. These idols, though much smaller, closely resemble those of Copan in workmanship, and were no doubt dedicated to the same or very similar purposes. I have eight in my possession, ranging from five and a half to eight feet in height, and from four to five in circumference. The faces of most are mutilated,—an evidence of the fanatical zeal of the early Spaniards, who waged a war of extermination upon the superstitions of the aborigines.

"Some of the statues have the same elaborate head-dresses with others of Copan; one bears a shield upon his arm; another has a girdle, to which is suspended a head; and still another has rising above its head the sculptured jaws of an alligator.

"All are very ancient, and the places of their deposit have been handed down from one generation to another. The fragments of many are to be found within a few miles of Leon, and there must originally have been a great number scattered over the country. Perhaps the most remarkable locality, with the exception of the island of Ometepe, in Lake Nicaragua, is the island of Momotombita, in the Lake of Monagua. Many of the statues have been removed, some, I believe, having been sent abroad. Many still remain, but the largest of all I brought away with me, and shall send it to Washington. It seems that there were originally some thirty or forty of these statues, of various sizes, and more or less elaborately carved, arranged in one place, in the form of a square, all looking inward. The dimensions of the square cannot now be ascertained, but the few remaining figures and fragments show that the statement is correct. It is a singular fact, and another evidence of the prevalence in America of the doctrine of the two reciprocal principles of nature (the active and passive, male and female), that these figures were represented, some as male, and some as female.

"I must not forget to mention that there has lately been discovered, in the province of Vera Paz, 150 miles northeast of Guatemala, buried

in a dense forest, and far from any settlements, a ruined city, surpassing Copan or Palenque in extent and magnificence, and displaying a degree of art to which none of the structures of Yucatan can lay claim."

In a later letter, Mr. S. says:—"A short distance back from the city of Santiago de Nicaragua is the crater of an extinct volcano, filled with water. It is surrounded by bare cliffs, some 300 or 400 feet high, in all places perpendicular, and having but one narrow, precarious descent to the water. Upon these cliffs, at the height of 50 or even 75 feet, are paintings of the aborigines, precisely in the style and of the character of those found in the ancient Mexican and Guatemalan manuscripts. They more closely resemble those of the manuscript of the Royal Library of Dresden than any other, which manuscript, I am convinced, was of Guatemalan origin. In fact, some of the figures are identical, and amongst them stands out the symbolical feathered serpent! There was originally a large number of paintings, representing dances, processions, &c.; but, unfortunately, the wall of rock upon which they were painted was thrown down only four years ago by an earthquake."

HINDOO ANTIQUITIES.

At a late meeting of the Asiatic Society, in London, a letter was read from Captain Kittoe, communicating an account of his archæological researches. He had recently recovered the inscription from Sarnath, dated Samrat, 1083, which mentions the rebuilding of *chaityas* at Sarnath by Nayapala and his sons, and the endowment of *viharas*, as at Kasi. From other inscriptions, he has obtained evidence that Buddhism flourished in the tenth and eleventh centuries of the Christian era. He has procured several miniature temples, varying from five feet in height down to as little as fifteen inches; and thinks that the practice of setting up numbers of these diminutive models must have been common to Buddhists, Jains, and Hindoos; but does not believe that any of the Hindoo works go beyond the tenth century.

A letter to Colonel Sykes from Captain Gill, the officer employed by the East India government in delineating the paintings in the Ajunta Caves, was read, in which that officer described a series of paintings which have since been received at the India House. The paintings described by Captain Gill are chiefly from the veranda of the cave usually known as the Zodiac Cave, and they represent a variety of scenes, mostly of social and domestic life. Among them is one of a marriage procession, which deserves especial notice; it displays a superior knowledge of drawing, and affords evidence of an acquaintance with the rules of perspective. Captain Gill states that he has discovered some very perfect inscriptions, which he thinks may relate to the paintings around, and which will probably help to determine the age of the caves. In one of the sanctuaries there are two rows of figures, and beneath each of them a single word; and below these is a continued line of writing, the letters of which are very perfect.

[redacted]

IMPORTANT DISCOVERIES IN ABYSSINIA.

M. Rocher d'Hericourt, who has lately returned from a voyage to Abyssinia, has brought with him above a score of manuscripts in the Ethiopian language, all of vast antiquity and great literary value. They are folio in form, bound in red leather, with the Greek cross and strange ornaments on the covers. In some of them the writing runs across the page; in others it is in columns; in nearly all it is firm and bold in character. Some of the manuscripts are on history, religion, and science; one is a complete and very curious treatise on the mystery of Eastern astrology; and one, which appears to have been written at the beginning of the 11th century, contains a copy of the Bible, which differs in some respects from the ordinary version.—*London Literary Gazette.*

NEW STATUE DISCOVERED AT ROME.

During the month of November, in the course of some excavations in the Transtevere, in Rome, a statue of a wrestler was discovered, wrought in Greek marble. It is of a semi-colossal size, and many artists, who have examined it, say that it is in merit at least equal, if not superior, to the Apollo Belvedere. It very much resembles a statue described by Pliny.—*London News.*

TOMB OF THE EMPEROR NAPOLEON.

A French paper gives the following details relating to works for the tomb of the Emperor Napoleon. An immense circular crypt has been dug beneath the dome; within which, on three shafts of green marble, the sarcophagus containing the Emperor's coffin will repose. A huge block of porphyry, presented by the Emperor of Russia, is destined to cover the sarcophagus. A lower gallery, paved with mosaics, and lined with marble bas-reliefs, representing the principal events of the Emperor's life, will admit the public to move around the sarcophagus. Twelve colossal statues, in white marble, will sustain an upper gallery, whence the sarcophagus may be looked down on and its details examined from above. These allegorical statues, from the chisel of Pradier, represent the principal branches of human activity,—science, legislation, war, arts, &c. A magnificent altar of black marble, veined with white, rises in front of the tomb. Four large and beautiful columns, also of black and white marble, support the canopy of carved and gilt wood. Ten broad steps, each cut from a single block of Carrara marble, lead up to the funeral altar. Beneath this altar is the passage to the lower gallery above spoken of; whose entrance is guarded on either side by the tombs, in black marble, of Bertrand and Duroc,—dead marshals keeping wait at the door of the imperial dead. The marbles employed in the construction of this tomb cost not less than a million and a half of francs ($300,000), in the rough; the sculptures and bas-reliefs cost six hundred thousand francs ($120,000). The block of porphyry, for the

covering of the sarcophagus, weighs 45,000 kilograms (50 tons); its extraction and carriage to Paris cost one hundred and forty thousand francs ($28,000). It comes from the shores of Lake Onega. Between the tombs of Bertrand and Duroc a shrine will be erected to receive the sword of Austerlitz, the imperial crown, and eighty standards captured under the Empire.—*London Athenæum, March.*

SUBTERRANEAN MAP OF PARIS.

A SUBTERRANEAN map of Paris, commenced in 1844, is, it is said, nearly completed. It will form an atlas of forty-five sheets,—corresponding to a superficies of five hundred by three hundred metres. It will exhibit, quarter by quarter, all the labyrinthine sinuosities of the ancient quarries and catacombs over which Paris is built, with the corresponding edifices, squares, and streets above ground. The labors of the engineers in the execution of this work have been, says the *Journal des Debats*, of the most tedious and delicate nature. This may be imagined, when it is understood that every subterranean point has its corresponding exterior point, and that a double calculation is necessary for the precise marshalling of objects without over the tortuous lines (empty or encumbered) within. The map has been coördinated on the supposition of two axes; one figuring a meridian passing by the wall of the observatory, the other a line perpendicular to the first.

COMPARATIVE COST OF PUBLIC BUILDINGS.

THE following table of the comparative cost of public buildings in the United States is extracted from a work entitled "Hints on Public Architecture," by the chairman of the Building Committee of the Smithsonian Institute, Hon. Robert Dale Owen.

Names.	Location.	Material.	Style.	Cost per cubic foot of available contents.
Treasury Building,	Washington,	Aequia Creek Freestone,	Grecian, with colonnade,	42½ cents.
U. S. Patent-Office,	do.	do. do.	do. with portico,	33½ "
General Post-Office,	do.	Marble,	Italian or Palladian,	42¼ "
Custom-House,	New York,	Marble,	Grecian, with porticos,	126 "
Custom-House,	Philadelphia,	Marble,	do. do.	53¾ "
Custom-House,	Boston,	Granite,	Roman, dome and porticos,	125 "
Girard College for Orphans,	Philadelphia,	Marble,	Grecian, with peristyle,	84½ "
Smithsonian Institution,	Washington,	Seneca Creek Freestone,	Norman, with towers,	17¼ "
Free Academy,	New York,	Brick,	Gothic, with clere-story,	9 "

NORTHEASTERN BOUNDARY.

THE boundary-line between the United States and Canada, run in accordance with the Ashburton treaty, cost the labor of three hundred

men eighteen months. "For three hundred miles a path was cut through the forest, thirty feet wide, and cleared of all trees. At the end of every mile is a cast-iron pillar, painted white, square, four feet out of the ground, seven inches square at the bottom, and four at the top, with raised letters on its sides, naming the commissioners who ran the line, and the date."—*Montreal Courier.*

AMERICAN ASSOCIATION FOR THE PROMOTION OF SCIENCE.

THE annual meeting, for 1849, of the American Association for the Promotion of Science, commenced at Cambridge, Mass., on the 14th of August, and continued until Tuesday, the 21st, being the longest session yet held by this body. A large number of scientific gentlemen were in attendance from all parts of the country. The division of the Association into two sections—1st, of General Physics, and 2d, of Natural History—took place on the second day, and before the close of the meeting, a further subdivision was made into four sections, of Physics, Chemistry, Geology, and Zoölogy. "The great improvement, both in quantity and quality of the matter offered, over that of any previous year, was very observable to those who have followed the sessions of this body from its origin, in the convention of geologists at Philadelphia, in 1840, to its present enlarged and comprehensive form of usefulness. It was obvious that the Association had now become truly national in character, and had taken deep hold of the feelings of men of science and investigators in all departments of knowledge. This manifestation is the best earnest of the future energy and prosperity of the institution, and gives encouraging hope for further progress and greater usefulness." The officers of the Association were Professor Joseph Henry, President, Professor E. N. Horsford, Secretary, Dr. Ellwin, Treasurer.

The whole number of papers read before the Association amounted to one hundred and sixteen, many of them of considerable length and of great interest. The time was also partially occupied with discussions.

The next annual meeting of the Association is to be held at New Haven, Conn., according to an invitation from the officers of Yale College. There is also to be a semiannual meeting held at Charleston, South Carolina, in March. The President for 1850 is Dr. Alexander Dallas Bache, the Secretary, Edward C. Herrick, Esq., and Dr. Ellwin, Treasurer. The session will commence on Monday, August 19th, 1850.

SCIENTIFIC REPORTS.

WE extract the following well-merited notice from the November number of *Silliman's Journal.*

"The proceedings of the American Association for the Promotion of Science were published at length in the *Boston Evening Traveller*, the reports of the discussions and papers being exceedingly accurate and full. We may add a word in behalf of this daily paper, pub-

lished in Boston, as we have long appreciated its excellence. The various scientific and literary addresses and lecturers of Boston and its vicinity are reported by it in full, and by stenographers that rarely miss a word that falls from the speaker's mouth. We are indebted to the editors in this way for the publication of Agassiz's lectures on embryology, which we have been assured, by those who know, are given with remarkable accuracy. The Lowell Lectures, of Boston, by men of the highest standing in their departments, may, through this paper, be enjoyed in distant portions of our country. We may hope, therefore, that the *Boston Evening Traveller* will widely travel, for it is one of the most important means in our country of disseminating scientific and literary information."

A similar praise to that awarded to the publishers of the *Evening Traveller* should also be given to the proprietors of the *New York Tribune*, which also reported the proceedings of the Association, but at less length.—*Editors.*

THE BRITISH ASSOCIATION.

The British Association for the Advancement of Science held its 19th annual meeting at Birmingham, on the 13th of September, 1849. The weather was extremely unpropitious, and not more than one thousand persons, including strangers and members of the Association, were present. The Marquis of Northampton made a few opening remarks, after which Professor Robinson delivered an address, in the course of which he referred to some of the works which the Association has accomplished since its establishment, eighteen years ago. They have published a Catalogue of 8,400 stars, of which work no one can form an adequate conception, without reflecting that the determination of each star involved upwards of 400 figures and above 50 arithmetical operations. This great work cost $10,000, and was completed with the aid of such men as Herschel, Bailey, and others, whose labor is above all price. The Association has expended about $75,000, and in all cases the members have rendered their services gratuitously.

[redacted]

PATENTS.

TABLE SHOWING THE NUMBER OF PATENTS ISSUED DURING EACH MONTH IN THE YEAR 1849.

[The classes into which they are divided are arbitrarily taken, and each class includes all patents in any way relating to it, which are not placed in a class by themselves. This and the following tables are compiled from the weekly lists which appear in the *New York Scientific American*, and *Farmer and Mechanic*.]

Month.	Patents.	Designs.	Reissues.	Total.	Railroads.	Steam-engines.	Telegraphs.	Machines.	Stoves.	Music.	Gold-washing Machines.	Agriculture.	Improved Processes.	Miscellaneous.
January,	75	1		76	11	1	1	19	8	1		9	8	18
February,	71		1	72	1	7	1	16	8	1		7	6	25
March,	94	2	5	101	3	4	2	32	9	1		9	14	27
April,	152	9	1	162	6	8	1	52	8	3	3	12	13	56
May,	88	1	3	92	5	3	1	23	4		1	13	14	28
June,	74	4	2	80	6	2		8	11	4	1	21	5	22
July,	60	1	1	62		2		21	2	1		11	11	14
August,	61	2	1	64	2	3		12	3	1	1	5	10	27
September,	65	4	5	74	4	1		23	11			11	4	20
October,	91	13	4	108	3	7	2	30	21			6	11	23
November,	74	4	1	79	2	4		21	5	1	5	15	10	21
December,	78	6	9	93	6	3		28	8	1		8	14	25
Totals,	983	47	33	1063	49	45	8	285	98	14	11	127	120	306

TABLE SHOWING THE NUMBER OF PATENTS ISSUED TO CITIZENS OF THE UNITED STATES.

Maine,	20	North Carolina,	3	Illinois,	19
New Hampshire,	28	South Carolina,	4	Missouri,	11
Vermont,	22	Georgia,	5	Florida,	2
Massachusetts,	156	Alabama,	8	Texas,	0
Rhode Island,	13	Mississippi,	2	Iowa,	4
Connecticut,	62	Louisiana,	5	Wisconsin,	1
New York,	328	Arkansas,	0	District of Columbia,	11
New Jersey,	40	Tennessee,	4	Foreign,	15
Pennsylvania,	153	Kentucky,	9	Not stated,	2
Delaware,	3	Ohio,	84		
Maryland,	25	Michigan,	9	Total,	1,063
Virginia,	12	Indiana,	13		

REPORT OF THE COMMISSIONER OF PATENTS FOR 1849.

THE Report of the Commissioner of Patents, Mr. Ewbank, for 1849, has been sent to Congress, but is not yet printed, though portions of it have been published in New York. In addition to the usual matter, Mr. Ewbank gives essays on the "Origin and Progress of Invention," "The Motors—Chief Levers of Civilization," and on "The Propulsion of Steamers."

The number of patents issued is larger than ever before, though over 1,400 applications have been rejected. On January 1st, 1849, 539 claims remained unacted upon, but the force having been increased, this number was reduced to 9 on January 1st, 1850. The inventors' fund amounts to \$169,505.17, exclusive of \$50,000 appropriated for the completion of the Patent-Office. Mr. Ewbank proposes to devote this to the "publication of the specifications and drawings," to the "preparation of a general analytical and descriptive index of discoveries and inventions," and to a fund for "national premiums," the interest of \$100,000 to be distributed once in four years. He proposes medals of Franklin, Fulton, and Whitney, and a prize of \$10,000 for an economical locomotive plough; \$20,000 for an improvement enabling a vessel to make three consecutive trips across the Atlantic at the rate of 20 miles per hour, \$20,000 for the same at 25 miles per hour, and \$100,000 for a means of using *electricity*, or *atmospheric pressure*, as a propelling power, or for the development of an *explosive*, or other prime mover, to take the place of steam.

WHOLE NUMBER OF PATENTS ISSUED TO CITIZENS OF THE SEVERAL STATES FROM 1790 TO 1849.

[Abridged from a table in the Report of the Commissioner of Patents for 1848, which is evidently the product of laborious investigation.]

	No. of Patents.	Ratio to population as estimated in 1848.		No. of Patents.	Ratio to population as estimated in 1848.
Maine,	494	1 to 124	Alabama,	71	1 to 10,084
New Hampshire,	366	1 " 841	Mississippi,	37	1 " 18,108
Vermont,	353	1 " 878	Louisiana,	80	1 " 6,125
Massachusetts,	2,221	1 " 394	Arkansas,	1	1 " 200,000
*Boston,	639		Tennessee,	132	1 " 7,424
Rhode Island,	257	1 " 525	Kentucky,	197	1 " 4,517
Connecticut,	1,193	1 " 285	Ohio,	775	1 " 2,554
New York,	4,904	1 " 465	Michigan,	53	1 " 7,924
*New York City,	1,757		Indiana,	117	1 " 8,547
New Jersey,	480	1 " 885	Illinois,	69	1 " 11,594
Pennsylvania,	2,222	1 " 999	Missouri,	49	1 " 1,229
*Philadelphia,	965		Florida,	1	1 " 80,000
Delaware,	71	1 " 1,197	Texas,	4	1 " 37,500
Maryland,	678	1 " 752	Iowa,	2	1 " 75,000
*Baltimore,	477		Wisconsin,	10	1 " 25,000
Virginia,	532	1 " 2,434	Dist. of Columbia,	227	1 " 211
North Carolina,	140	1 " 5,571	Foreign,	192	
South Carolina,	131	1 " 4,733			
Georgia,	78	1 " 10,706	Total,	16,137	1 " 1,360

* Included in the totals for the States in which these cities are situated.

OBITUARY

OF PERSONS EMINENT IN SCIENCE OR ART. 1849–50.

Louis Count Batthyany, once Prime Minister of Hungary, and a distinguished patron of science. Shot by order of Gen. Haynau.

Carl F. Becker, the German philologist.

Andrew Bell, a distinguished Scotch philosopher and mathematician.

Bishop of Norwich, President of the Linnæan Society of London.

Dr. Amariah Brigham, Superintendent of the New York State Asylum for the Insane, at Utica. He was distinguished, as a physician, for his successful practice, and stood in the first rank of medical writers.

Sir I. Brunel, Vice-President of the Royal Society and of the Institution of Civil Engineers. Born in France, in 1769, but during the Revolution emigrated to America, where he built the first Bowery Theatre in New York. He soon went to England, where he invented a circular saw for cutting veneers, built steamboats, and, as engineer of the Thames Tunnel, gained great renown.

Henry Coleman died of fever at Islington, London. He was a learned and able clergyman, an enlightened writer on agriculture, and had been Agricultural Commissioner for the State of Massachusetts.

James Dean, LL. D., Professor of Mathematics and Natural Philosophy in the University of Vermont, and a member of the American Academy of Arts and Sciences.

Wolfgang Dobereiner, a distinguished chemist.

Edward Doubleday, a distinguished British naturalist. He visited America in 1835, and made a large collection of specimens in all branches of natural history. He was Assistant in the Zoölogical Department of the British Museum, where he devoted himself particularly to the Lepidopterous insects, and had formed a most perfect collection of butterflies and moths.

Prof. David Douglass, Professor of Mathematics in Geneva College, N. Y.

John Duncan, the English traveller in Africa. He accompanied the expedition to the Niger, in 1842, and afterwards explored the country in various directions.

Prof. Julius Ducatel, of Baltimore, Md.

Prof. Stephen Endlicher, Professor of Botany at Vienna. He was well known, both as a botanist and as an accomplished philologist, and held the situation of Librarian of the Imperial Library at Vienna.

William Etty, a well-known painter.

Dr. George Fownes, Professor of Practical Chemistry in the University College, London, and author of a Manual of Chemistry.

Edward Forster, Esq., Vice-President of the Linnæan Society of London.

Hon. Albert Gallatin. Born in Geneva, Switzerland, in 1761; came to America, 1780; Professor of French in Harvard University, 1782; Secretary of the Treasury under Jefferson, 1801; Minister to Russia, 1815, to France, 1816, to England, 1826. He paid great attention to ethnological studies, and wrote much on this subject.

Dr. Martin Gay, a distinguished chemist of Boston.

Gottfried Hermann, Professor in the University of Leipsic, and a well-known philologist.

John H. Kyan, the inventor of a chemical process for indurating wood, known as "Kyanizing." At the time of his death he was making some experiments for the purification of water, and was in communication with the Directors of the Croton Water-Works on this subject. He died very suddenly, in New York.

M. Laureani, Assistant Librarian of the Vatican, at Rome.

Mr. Charles Lyell, in Scotland, father of Sir Charles Lyell, the geologist.

Cardinal Mezzofanti, the distinguished linguist.

Thomas Morton, Surgeon to the University Hospital, London, and to the Queen's Bench Prison. He committed suicide by taking prussic acid.

John Gaspard Orelli, a Swiss historian and philologist.

Jacob Perkins, a distinguished engraver and inventor.

Dr. Prichard, well known as the author of "Researches into the Physical History of Man," and various ethnographical and physiological writings. President of the British Ethnological Society.

Hon. Nathan Reed, of Maine, aged 89, a member of the American Academy, and the first petitioner for a patent for an invention before the patent-law had been enacted. He was the first who applied steam for navigation, and made numerous experiments before Fulton succeeded.

Dr. John Reed, Professor of Anatomy and Medicine in the College of St. Andrews, Scotland. Author of Physiological, Anatomical, and Pathological Researches.

Signor Sarti, of Rome.

Sir Charles Scudmore, author of a treatise on rheumatism and tic-douloureux, of an essay on the blood, &c.

Ludwig Seebeck, author of works on optics and acoustics. Member of the Berlin Academy, and Professor of Natural Philosophy at Leipsic.

Neil Snodgrass, Esq., in Scotland, the inventor of metallic packing for steam-engines, and of various useful machines.

Prof. Thompson, Professor of Natural Philosophy in the University of Glasgow.

Dr. Tytler, the historian.

Signor de Vico, an eminent astronomer, formerly of Rome, afterwards Professor in Georgetown (D. C.) College. Distinguished for his astronomical labors and discoveries.

Lieut. Thomas Waghorn, the originator of the overland route to India. By his repeated journeys and great exertions he entirely ruined his health, so that his death cannot be ascribed to any particular disease.

Major George W. Whistler, died of cholera at St. Petersburg, Russia. He was a graduate of the West Point Academy, and for some time remained in the army, but left it to take up the profession of civil engineer. He had charge of several important works in this country, and stood at the head of his profession. Was invited to Russia by the Emperor Nicholas, and placed in charge of the construction of the railroad from St. Petersburg to Moscow, which he had nearly completed at the time of his death.

David H. Williams, geologist to the East India Company. He fell a victim to the pestilential atmosphere of the jungles of Hindostan, while engaged in scientific pursuits.

Dr. Samuel Woodward, for many years Superintendent of the Massachusetts State Lunatic Asylum at Worcester. He was very successful in his treatment of the insane, and his opinion was much sought after.

LIST OF BOOKS

ON MATTERS PERTAINING TO SCIENCE, PUBLISHED IN THE UNITED STATES DURING THE YEAR 1849.

American Almanac for 1850. Little & Brown. Boston.

Anæsthesia, or the Employment of Chloroform and Ether in Surgery, Midwifery, &c. Lindsay & Blakiston. Philadelphia.

Ancient Monuments of the Mississippi Valley, by E. G. Squier and E. H. Davis. Smithsonian Institute.

Annals of the Lyceum of Natural History of New York. Vol. V. No. I. Putnam. New York.

Aspects of Nature, by Humboldt. Lea & Blanchard. Philadelphia.

Atlas of the Report on the Zoöphytes of the Exploring Expedition, by Dana. Lea & Blanchard. Philadelphia.

Catalogue of Plants collected in the Vicinity of Cincinnati, by T. G. Lea. Philadelphia.

Catalogue of Skulls of Men and the Inferior Animals in the Collection of G. Morton, M.D. Philadelphia.

Catechism of the Steam-engine, by Bourne. Appleton. New York.

Chemical Analysis, Qualitative and Quantitative, by Wood. Edited by Morfit. Lindsay & Blakiston. Philadelphia.

Chemical and Pharmaceutical Manipulations, by Morfit. Lindsay & Blakiston. Philadelphia.

Chemical Technology, by Knapp. Edited by Johnson. Lea & Blanchard. Philadelphia.

Description of a System of Military Bridges, with India-rubber Pontoons, by Captain *G. W. Callum*. Washington.

Dictionary of Machines, Mechanics, and Engineering, by Byrne. Appleton. New York.
Earth and Man, by Prof. Guyot. Gould, Kendall & Lincoln. Boston.
Effects of Chloroform and Strong Chloric Ether as Narcotic Agents, by J. C. Warren, M.D. Ticknor & Co. Boston.
Elementary Treatise on Optics, by J. W. Jackson. A. S. Barnes & Co. New York.
Elements of Chemistry and Electricity, by Reid and Bain. Edited by Reese. A. S. Barnes & Co. New York.
Elements of Meteorology, by Brocklesby. Pratt, Woodford & Co. New York.
Etherization in Child-birth, by W. F. Channing. Ticknor & Co. Boston.
Ethnography of the Exploring Expedition, by Pickering.
Exploring Expedition to the Rocky Mountains, Oregon, and California, by Fremont. G. H. Derby & Co. Buffalo.
Genera of the Plants of the United States, by Sprague. Superintended by Gray. Putnam. New York.
Geology of the United States Exploring Expedition, by Dana. Putnam. New York.
Geological Survey of Canada, by Logan. Montreal.
Geometry and Faith, by Hill. Francis & Co. Boston.
History of Ancient Art, by Winckleman. Translated by G. H. Lodge. James Munroe & Co. Boston.
History and Chemical Investigation of Maize, by J. H. Salisbury. Albany.
Human Anatomy, by Quain and Sharpey. Edited by Leidy. Lea & Blanchard. Philadelphia.
Iconographic Encyclopædia of Science, Literature, and Art, by Heck. Translated by Baird. Garrigue. New York.
Introduction to Practical Chemistry, by Bowman. Lea & Blanchard. Philadelphia.
Lectures on Embryology, by Agassiz. Flanders. Boston.
Lectures on Comparative Physiology, by Wyman. Flanders. Boston.
Man Primeval: a Contribution to Theological Science, by John Harris, D.D. Gould, Kendall & Lincoln. Boston.
Manual of Road-making, by Gillespie. A. S. Barnes & Co. New York.
Manufacture of Iron, by Overman. H. C. Baird. Philadelphia.
Mechanical Principia, by E. C. Leonard. Leavitt, Trow & Co. New York.
Mechanic's Assistant, by Knapen. Appleton. New York.
Medical Chemistry, by D. P. Gardner. Philadelphia.
Memoir on the Geological Action of the Tidal and other Currents of the Ocean, by Lieut. Davis. Cambridge.
Miner's Guide and Metallurgist's Directory, by J. W. Orton. A. S. Barnes & Co. New York.
Mohr and Redwood's Pharmacy, by Proctor. Lea & Blanchard. Philadelphia.
Narrative of the late Expedition to the Dead Sea, by Montague. Carey & Hart. Philadelphia.
Narrative of the United States Expedition to the River Jordan and the Dead Sea, by Lynch. Lea & Blanchard. Philadelphia.
Natural and Experimental Philosophy for Schools. A. S. Barnes & Co. New York.
Nineveh and its Remains, by A. H. Layard. Putnam. New York.
Notes on the Medical Application of Electricity, by W. F. Channing. Ticknor & Co. Boston.
Observations on a new Living Species of the Hippopotamus of Western Africa, by Morton. Philadelphia.
Outlines of Astronomy, by Herschel. Lea & Blanchard. Philadelphia.
Present Earth, the Remains of a Former World. Address before S. Carolina Institute, by R. W. Gibbes. Columbia.
Principles of the Mechanics of Machinery and Engineering, by Weisbach. Edited by Johnson. Lea & Blanchard. Philadelphia.
Proceedings of the American Academy of Arts and Sciences. Flanders. Boston.
Report of the Commissioner of Patents for 1848, by Burke. Washington.
Report of the Commissioner of Patents, Part 1, for 1849, by Ewbank. Washington.
Report of the Regents of the Smithsonian Institute. Washington.
Report of the Regents of the University of New York. Albany.
Report of Experiments on Gunpowder, by Maj. Mordecai. Washington.
Report of the Coast Survey of the United States, by Bache. Washington.
Researches on the Capillary Circulation, by Dowler. Weld & Co. New Orleans.
Sailor's Horn-book for the Law of Storms, by H. Piddington. Wiley. New York.
Second Visit to the United States, by Lyell. Harper & Co. New York.
Service-Pipes for Water, by E. N. Hosford. Cambridge.
Tables and Formulæ useful in Geodesy and Astronomy, by Capt. J. T. Lee. Washington.
Transactions of the American Ethnographical Society. Bartlett & Welford. New York.
Western America, including California and Oregon, by Charles Wilkes. Lea & Blanchard. Philadelphia.

INDEX

TO ARTICLES IN SCIENTIFIC JOURNALS AND REPORTS.

Abbreviations used in the following Index.

Acad. of Nat. Sci. stands for Journal of the Academy of Natural Sciences, of Philadelphia.
Am. Ass., for Proceedings of the American Association for the Advancement of Science.
Am. Acad., for Memoirs of the American Academy of Arts and Sciences, of Boston.
Ann. Lyceum Nat. Hist., for Annals of the Lyceum of Natural History, of New York.
Ann. des Sci. Nat., for Annales des Sciences Naturelles. Paris.
Ann. der Chem. und Pharm., for Annalen der Chemie und Pharmacie.
Astron. Jour., for Astronomical Journal. Cambridge.
Ath., for London Athenæum.
Brewster, for London, Ed nburgh, and Dublin Philosophical Magazine.
Brit. Ass., for the British Association for the Promotion of Science.
Bul. de la Soc. d'En., for Bulletin de la Société d'Encouragement.
Chem. Gaz., for Chemical Gazette. London.
Civil Eng. and Arch. Jour., for Civil Engineers' and Architects' Journal. London.
C. R., for Comptes Rendus of the French Academy.
Jameson, for Jameson's New Philosophical Magazine.
Jour. of F. I., for Journal of the Franklin Institute of Philadelphia.
Jour. de C. et de P., for Journal de Chimie et de Physique. Paris.
Jour. des Sav., for Journal des Savans. Paris.
Jour. de Pharm., for Journal de Pharmacie. Paris.
Mag. of Nat. Hist., for Annals and Magazine of Natural History. London.
Min. Jour., for Mining Journal. London.
Nat. Hist., for Proceedings of the Boston Natural History Society.
Philos. Soc. Proc., for Proceedings of the American Philosophical Society, of Philadelphia.
Phil. Trans., for Philosophical Transactions. London.
Pogg., for Poggendorff's Annalen der Chemie.
Poly. Jour., for Dingler's Polytechnische Journal.
Proc. Am. Acad., for Proceedings of the American Academy of Arts and Sciences, of Boston.
Sill., for Silliman's Journal. New Haven.
Trav. de Chim., for Travaux de Chimie. Paris.

MECHANICS, AND USEFUL ARTS.

[redacted]

NATURAL PHILOSOPHY.

Photochromatic image of the solar spectrum. Becquerel. C. R., Feb. 12.
Propagation of electricity in solid non-conducting bodies. Matteuci. Ann. de C. et de P., Oct.
Rays, simple luminous. Cauchy. C. R., Jan. 8.
Reflection and refraction of light and some new rays. Cauchy. C. R., Jan. 15.
" of light from the surface of transparent bodies. C. R., Jan. 22.
Sea, temperature of, near the glaciers of Spitzbergen. Martins. Ann. de C. et de P., Vol. 25, p. 172.
Simple luminous rays. Cauchy. C. R., Jan. 8.
Sounds, multiple, of bodies. Duhamel. Ann. de C. et de P., Vol. 25, p. 45.
Steam, magnetism of. Phillips. Brewster, Supplement to Vol. 34.
Terrestrial thermotics. Hunt. Am. Ass., p. 135.
Vibration of Trevelyan's bars by the galvanic current. Page. Sill., Jan. 1850.
Vision, phenomena of, with two eyes. Foucault and Regnault. C. R., Jan. 15.
Volatilization of carbon. Sill., Nov.
Voltaic arc. Matteuci. C. R., Sept. 3. Brewster, Oct.

CHEMICAL SCIENCE.

Adulteration of chloroform and means of detecting it. Poly. Jour., No. 632.
" of flour. Le Canu. Jour. de Pharm., April.
Ale and Porter, organic constituents in. Dickson. Sill., Jan.
Ammonio-chloride of magnesium. Am. Ass., p. 235.
Antimony, estimation of. Rosè. Chem. Gaz., Oct. 1.
Arsenic, quantitative estimation of. Pogg., 334, No. 4.
Atmosphere, moisture of. Dove. Pogg., 369, No. 7.
Bile of different animals, chemical examination of. Chem. Gaz., p. 427.
Bones, chemical composition of. Heintz. Pogg., 267, No. 6.
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